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STATUS OF ATLANTIC SALMON (*Salmo salar* L.) STOCKS OF THREE SELECTED RIVERS IN SALMON FISHING AREA 14A, 1996

by

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Abstract

The mean counts of small and large Atlantic salmon at counting facilities on Lomond River, Torrent River and Western Arm Brook in 1992-96 (moratorium years) were greater than the 1984-91 (pre-moratorium years) means. The mean smolt-to-adult survival rate on Western Arm Brook in 1992-96 was also greater than the 1984-91 mean. Conservation egg deposition and spawner requirements were exceeded on all three rivers in 1992-96. On the basis of the recruit-to-spawner relationships, the recruitment of small salmon in 1997 is expected to be greater than in 1996 on Lomond River and Torrent River, provided the smolt-adult survival rate remains the same as in 1996. Spawning escapements are expected to exceed conservation requirements on all three rivers in 1997. The total population size of small salmon on all three rivers in 1992-96 was less than in 1984-91. Even with increased recruitment, this trend is not expected to change in 1997.

Résumé

Les valeurs moyennes du dénombrement des petits et des grands saumons atlantique aux barrières des rivières Lomond et Torrent et au ruisseau Western Arm obtenues de 1992 à 1996 (années du moratoire) sont supérieures à celles obtenues de 1984 à 1991 (avant le moratoire). La moyenne du taux de survie saumoneau-adulte pour le ruisseau Western Arm de 1992 à 1996 est aussi supérieure à la valeur moyenne correspondante de 1984 à 1991. Les exigences de conservation en matière de ponte et de géniteurs ont été dépassées dans ces trois cours d'eau de 1992 à 1996. Selon les rapports entre les nombres de recrues et de géniteurs, le recrutement de petits saumons en 1997 devrait être supérieur à celui de 1996 dans les rivières Lomond et Torrent, si le taux de survie saumoneau-adulte est le même qu'en 1996. Les échappées de géniteurs devraient être supérieures aux besoins de conservation dans les trois cours d'eau en 1997. L'effectif total de la population de petits saumons des trois cours d'eau, de 1992 à 1996, a été inférieur à celui de la période 1984 à 1991. Cette tendance devrait se maintenir en 1997, même avec un recrutement accru.

INTRODUCTION

Lomond River, Torrent River, and Western Arm Brook are three of fourteen scheduled rivers in Salmon Fishing Area (SFA) 14A (Fig. 1). The returns of adult Atlantic salmon to the counting facilities on Lomond River and Torrent River have been monitored since the 1960s and on Western Arm Brook since 1971. The smolt output on Western Arm Brook has also been monitored since 1971. The fishways on Lomond River and Torrent River are located approximately 5.0 km and 2.0 km upstream from the mouth of each river. The counting fence on Western Arm Brook is located just above the head of tide.

The recreational fisheries on these rivers are controlled on an individual river basis. On Lomond River, the fishery has been permitted only downstream from the fishway since 1978 and is controlled by a river quota of 375 retained small salmon. The quota was increased to 375 in 1995 from 350 which was in place since 1986. On Torrent River, the fishery is also permitted only downstream from the fishway and catch and release angling only is permitted until a minimum spawning escapement of 750 salmon have passed upstream through the fishway. Catch and retain angling is then permitted. This minimum spawning escapement was reduced to 750 fish in 1995 from the 1,000 that had been in place since the 1970s. Prior to 1996, catch and release angling was not permitted prior to the minimum spawning escapement being achieved. The recreational fishery on Western Arm Brook has been closed since 1989.

This is the fifth year of the five year commercial salmon fishery moratorium which was implemented in 1992. This was a major management initiative to stop the decline in salmon stock abundance. The moratorium was aimed at reducing commercial fishing mortality in order to provide the potential for increased river returns. In addition, recreational fishing mortality has been controlled since 1992 to increase spawning escapements. It must be kept in mind that, although the commercial salmon moratorium was implemented in SFA 14 A in 1992, the commercial cod fishery moratorium was not implemented in SFA 14A until August 1993 and, as a result, the potential still existed in 1992 for by-catch of salmon at sea because of the presence of cod traps.

The effect of the commercial salmon fishery moratorium on salmon stock abundance can be evaluated on Lomond River, Torrent River and Western Arm Brook by comparing the recruitment in the moratorium years (1992-96) with recruitment in pre-moratorium years (1984-91). The effect of the moratorium on the sea-survival of smolts can also be evaluated based on the smolt output and subsequent adult returns at Western Arm Brook. The spawning escapements on these rivers can also be evaluated relative to the conservation egg deposition and spawner requirements. The relationship between spawners an subsequent recruitment as well as previous smolt-to-adult survival rate can be used to estimate recruitment in 1997.

METHODS

RECREATIONAL FISHERY DATA

Recreational fishery data on Lomond River and Torrent River in 1996, as in previous years, was compiled from weekly reports of small (<63 cm) and large (>= 63 cm) salmon catches completed by Department of Fisheries and Oceans (DFO) river guardians (Mullins et al., MS 1989; Mullins and Jones, MS 1993a; and Mullins and Jones, MS 1993b). The recreational fishery on Western Arm Brook remained closed for the 1996 season.

BIOLOGICAL CHARACTERISTICS

The biological characteristics (mean weight females, proportion female) data used to estimate the potential egg depositions by salmon on Lomond River, Torrent River, and Western Arm Brook in 1983-96 are given in Tables 1-3. Because samples sizes in some years were small (<30), pooling of data was sometimes necessary. Biological information was obtained from sampling conducted at the counting facilities and in the recreational fishery. Sex composition was determined by internal and external examination at the counting facilities and internal examination in the recreational fishery.

For egg depositions on the Lomond River and Torrent River in 1996, the percentage female used for small salmon was the 1992-96 mean for internally sexed fish. The percentage used for large salmon was the mean of the entire time series for both internally and externally sexed fish. For Western Arm Brook, the 1996 value for internally sexed fish was used for small salmon and the 1992-96 mean for both internally and externally sexed fish was used for large salmon. The information used for 1996 is summarized as follows:

River	Small Salmon				Large Salmon			
	Whole Weight Females (kg)				Whole Weight Females (kg)			
	Mean	STD	N	Proportion Female (N)	Mean	STD	N	Proportion Female (N)
Lomond	1.57	0.39	31	0.619 (84)	3.69	0.62	17	0.857 (15)
Torrent	1.71	0.30	18	0.781 (32)	4.28	0.84	22	0.645 (203)
WAB	2.04	0.37	29	0.806 (36)	4.28	1.21	58	0.775 (80)

Egg depositions on Lomond River in 1984-91 were based on the 1983-93 mean biological characteristics and those in 1992-93 were based on 1993 values for both small and large salmon. For Torrent River, egg depositions in 1990-93 were based on

1985-89 mean biological characteristics for small and large salmon. For Western Arm Brook, egg depositions in 1984-93 were based on 1984-93 biological characteristics for small and large salmon combined because of the small number of large salmon encountered. Egg depositions for all three rivers in 1994-95 were based on biological characteristics for each individual year.

Smolt-to-adult survival rate on Western Arm Brook was based on returns of virgin 1SW salmon.

TOTAL RIVER RETURNS

The total returns to the river (TRR) for small and large salmon were calculated separately based on counts at counting facilities and recreational fishery catches below counting facilities:

$$TRR = C + RET + REL \times 0.1$$

C = count of salmon at counting facility
RET = number of salmon retained
REL = number of salmon released

A catch and release mortality rate of 10% was assumed for small and large salmon based on consultations with anglers and it was assumed that catch and release mortality occurred only below the counting facilities. No adjustment was made for any other unrecorded mortalities below the counting facilities. Counting facilities were monitored on a daily basis in 1996. The period of operation for each river was as follows:

Counting Facility Location	**Period of Operation**
Lomond River Fishway	June 19 to November 18
Torrent River Fishway	June 19 to October 31
Western Arm Brook Counting Fence	May 3 to September 27

Counts of salmon at the Lomond River fishway were not obtained in 1989-91 but fish were observed passing through the fishway.

The spawning escapements were obtained by subtracting retained catches, catch and release mortalities and other known removals from the total returns.

The potential egg depositions above the counting facilities were calculated based on the total spawning escapement and observed biological characteristics (mean weight of females, percent female) of small and large and a relative fecundity of 1783 eggs/kg of body weight. This relative fecundity value was estimated from a sample of 264 female small salmon at Western Arm Brook in 1979-80 (Chadwick et al., 1986). Egg depositions were expressed as a percentage of the conservation egg deposition requirement.

CONSERVATION EGG DEPOSITION AND SPAWNER REQUIREMENTS

The conservation egg deposition requirements were calculated based on an optimal egg deposition rate of 2.4 eggs/m^2 (Elson, 1975) of fluvial parr rearing habitat (Elson, 1957) and 368 eggs/ha of lacustrine habitat on Lomond River and 105 eggs/ha on Torrent River and Western Arm Brook (O'Connell et al., 1991). The egg deposition rate for fluvial habitat includes an adjustment for poaching and disease, whereas, the rate for lacustrine habitat does not include an adjustment.

It is important to note that the amount of available fluvial habitat was measured from detailed stream surveys only for the Lomond River. For the Torrent River and Western Arm Brook, the available fluvial habitat was based on aerial surveys (Traverse, 1971). The available lacustrine habitat for the three rivers was measured from 1:50,000 scale topographic maps using the appropriate dot grid scale.

The conservation spawner requirements were calculated based on the 1992-96 mean weight and proportion of females to account for potential changes in these characteristics as a result of the elimination of selective commercial fishing mortality since 1992. The minimum proportion of large salmon and the maximum proportion of small salmon observed at the counting facilities in 1992-96 were used to apportion the spawner requirements into small and large salmon .

NUMBER OF RECRUITS AND SPAWNERS AND ANTICIPATED RETURNS IN 1997

O'Connell, et al. (MS 1996) describe a technique whereby it was possible to retrospectively construct total population size of small salmon (or total number of small salmon recruits) prior to any exploitation in selected rivers with counting facilities and to use the number of salmon recruits per spawner to estimate anticipated returns one year in advance. The technique is fully described in O'Connell, et al. (MS 1996) and equations used to derive recruits and spawners for Lomond River, Torrent River, and Western Arm Brook use the same assumed exploitation rate in the commercial fishery of 0.60 and the river escapements of small salmon on the three rivers were adjusted to reflect only virgin small salmon. The proportion of virgin small salmon used to adjust the river escapements on each river in pre-moratorium and moratorium years is given in Appendices 1-3. After 1992, the total return to the river of small salmon was assumed to represent the total population size of small salmon.

The smolt-age composition of small salmon on the three rivers was adjusted to reflect the predominant smolt age of adults. For example, on Western Arm Brook, the percentage of returns at smolt age 2+ was added to the 3+ group and the percentage at smolt-age 6+ was added to the 5+ group. The percentage at 2+ and 6+ was zero or minimal in most years. The 1994-96 average recruit to spawner (R/S) ratio for each smolt age group was used to estimate anticipated returns in 1997.

The anticipated spawners on Lomond River in 1997 were estimated from the anticipated recruitment by subtracting the recreational quota of 375 retained small salmon and 10% of the 1992-96 mean released catch of small salmon. The anticipated spawners on Torrent River were estimated from the anticipated recruitment based on an angling exploitation rate of 5% which is equivalent to the 1992-96 mean exploitation rate. The anticipated spawning escapement on Western Arm Brook in 1997 was assumed to be equivalent to the anticipated recruitment.

RESULTS

RECREATIONAL FISHERY

Recreational catches and effort on Lomond River and Torrent River are given in Appendices 4-5. The quota of 375 small salmon for Lomond River was reached on 13 August 1996 after which time the river remained open for catch and release angling but closed on 22 August due to low water levels and high temperatures. Torrent River opened to catch and release angling on 22 June 1996 and to catch and retain on 10 July.

Recreational catches on the Lomond River have been controlled by an individual river quota since 1986:

Year	Quota	Open	Closed	No. Days to Reach Quota
1986	350	7 June	25 July	49
1987	350	6 June	13 July	closed due to low water
3988	350	4 June	25 July	52
1989	350	17 June	23 July	closed due to low water
1990	350	16 June	24 July	39
1991	350	17 June	25 July	39
1992	350	13 June	24 July	42
1993	350	12 June	20-31 Jul. & 8 Aug.-6 Sept.	SFA quota reached
1994	350	11 June		Quota not reached
1995	375	24 June	24 July	31
1996	375	22 June	13 Aug.	53

Other catch and effort controls such as SFA quotas, reduced bag limits and split seasons were also in place is some years, particularly since 1992, and these may have been responsible for preventing the quota from being reached earlier in the season.

The retained plus released catches of small salmon and released catches of large salmon on the Lomond River in 1996 were 13% and 21% less than in 1995 but were above the 1984-91 and 1978-83 means (Appendix 4). The catches of small and large salmon in both 1995 and 1996 were among the highest on record. The CPUE in 1995 was the highest in nine years but decreased in 1996 as a result of a 32% increase in angling effort compared to 1995 (Appendix 4).

During the five moratorium years (1992-96) on the Lomond River, retained plus released catches of small and released catches of large salmon have increased relative to pre-moratorium years (1984-91) (Appendix 4). However, CPUE has decreased as a result of an increase in angling effort.

The retained plus released catches of small salmon on the Torrent River in 1995 and 1996 were the highest on record and released catches of large salmon were the highest since 1965 (Appendix 5). However, the CPUE in 1995 and 1996 decreased in comparison to 1992 and 1993 as a result of large increases in angling effort.

During the five moratorium years on the Torrent River, with the exception of 1994, the retained and retained + released catches of small salmon were the highest on record. The catches of large salmon during the five moratorium years were the highest since 1965 (Appendix 5). CPUE increased in the first two years of the

moratorium but then decreased in the last three years as a result of an increase in angling effort that was two to four times the effort in pre-moratorium years.

COUNTS AT COUNTING FACILITIES

Counts of small and large salmon at the three counting facilities in SFA 14A are given in Table 4. The counts of small and large salmon at the Lomond River fishway in 1996 were less than in 1995 but were the third highest on record (Fig. 2). The count of small salmon at the Torrent River fishway was the highest on record and the count of large salmon was the second highest (Fig. 3). The count of small salmon at the Western Arm Brook counting fence was the second highest on record and large salmon was the highest (Fig. 4).

It was expected that the number of small salmon returning to Western Arm Brook in 1996 would be greater than in 1995 because of a 63% higher smolt count in 1995 compared to the previous year. As expected, the number of small salmon in 1996 was greater than in 1995 but was 8% less than expected because of a lower smolt-to-adult survival rate in 1996 compared to 1995 (Table 5).

The count of 14,502 smolts at the Western Arm Brook counting fence in 1996 was 4% less than in 1995 (Table 5). Assuming that the smolt-to-adult survival rate in 1997 is the same as in 1996 (8.1%), then the return of small salmon to the river in 1997 is expected to be 4% less than in 1996. The smolt-to-adult survival rate has increased each year since 1992 except for 1996 (Table 5; Fig. 5). The precision (%difference) of previous estimates of future adult returns using this method has been highly variable as a result of the high variability in sea-survival of smolts:

Year	Expected	Observed	% Diff.
1984	965	235	-75.6
1985	460	514	11.7
1986	334	525	57.2
1987	693	437	-37.0
1988	420	422	0.5
1989	380	455	19.8
1990	339	322	-4.9
1991	298	233	-21.9
1992	297	480	61.8
1993	550	947	72.3
1994	826	954	15.5
1995	659	823	24.8
1996	1342	1230	-8.4
1997	1175		

CONSERVATION REQUIREMENTS

Calculations of egg deposition requirements and the numbers of spawners required to achieve the conservation egg deposition on Lomond River, Torrent River and Western Arm Brook are shown in Tables 6-8. Egg depositions on the three rivers can be achieved by 580 (557 small and 23 large), 592 (562 small and 30 large) and 287 (284 small and 3 large) spawners, respectively.

TOTAL RIVER RETURNS, SPAWNING ESCAPEMENT, AND PERCENTAGE OF CONSERVATION EGG DEPOSITION REQUIREMENTS ACHIEVED

Total river returns, spawning escapements, potential egg depositions by small and large salmon and percentages of conservation requirements achieved in 1984-96 on Lomond River, Torrent River and Western Arm Brook are given in Table 9. The conservation egg deposition requirements above the counting facilities were exceeded on all three rivers in 1996 (143%, 1,279% and 415%, respectively).

TRENDS IN TOTAL NUMBERS OF RECRUITS AND SPAWNERS

The estimated numbers of small salmon recruits and corresponding spawners from each year class on Lomond River, Torrent River, and Western Arm Brook are given in Tables 10-12. The number of recruits relative to the number of spawners was quite variable on all three rivers but to a lesser degree on Lomond River and Torrent River, especially in recent years (Fig. 6A, 7A, 8A). The ratio of recruits to spawners (R/S) in 1996 compared to 1995 decreased on Lomond River but increased on Torrent River and Western Arm Brook. There was a significant trend in the R/S relationship in 1977-96 for Lomond River (R^2=0.3937; df=18; P<0.01) and for Torrent River (R^2=0.3838; df=18; P<0.01) but not for Western Arm Brook. However, for all three rivers the R/S ratios in 1996 and in the five moratorium years were among the lowest recorded (Fig. 6B, 7B, 8B). Expressing the conservation egg deposition requirements in terms of small salmon, it is evident for all three rivers that the number of spawners has increased and that the spawning requirements have been exceeded in the five moratorium years (Fig. 6C, 7C, 8C). The total population sizes of small salmon on the three rivers during the moratorium years were among the lowest recorded (Fig. 6D, 7D, 8D). However, the total population size on Torrent River showed a significant (R^2=0.4830; df=24; P<0.001) increasing trend over the time series. This was probably due to the enhancement program carried out on this river in the early 1970s.

ANTICIPATED RECRUITMENT AND SPAWNING ESCAPEMENTS IN 1997.

The returns of small salmon in 1997 are anticipated to be greater than in 1996 for Lomond River and Torrent River but less than in 1996 for Western Arm Brook (Fig.

6D, 7D, 8D). The total population size in 1997 on all three rivers is expected to be greater than the 1992-96 mean (Fig. 6D, 7D, 8D).

Assuming a recreational quota of 375 small salmon on Lomond River, an angling exploitation rate of 5% on Torrent River, no recreational fishery on Western Arm Brook and that natural survival rates remain the same, then the spawning escapements of small salmon in 1997 (based on the average R/S ratio in 1994-96) are anticipated to exceed the conservation requirements on all three rivers (Fig. 6C, 7C, 8C).

DISCUSSION

The mean adult returns and spawning escapements on Lomond River, Torrent River and Western Arm Brook improved in the 1992-96 (moratorium years) compared to the 1984-91 (pre-moratorium years). However, returns to Lomond River and Western Arm Brook in some pre-moratorium years, were greater than in some moratorium years. All three stocks exceeded their conservation egg deposition requirements in every moratorium year. However, because of annual variability and the effect of atresia on fecundity (O'Connell et al., MS 1997) as well as the potential for spawner mortality upstream of counting facilities and egg losses in the river, estimates of egg deposition should be treated as potential only. The estimate of relative fecundity used to calculate egg depositions for all three rivers was based on biological characteristics of Western Arm Brook salmon in 1979-80 (Chadwick et al., 1986) and should be revised for each river, given the potential for a change in body size of returning adults as a result of the moratorium. Other cautions associated with the parameter values used to estimate conservation requirements have been described in detail by O'Connell and Dempson (1995). These will not be discussed further here except to point out that habitat measurements on which conservation requirements for these rivers were based were taken from aerial surveys conducted in the early 1970s. Ground-truthing in recent years of aerial survey estimates of habitat on other rivers has revealed that these initial habitat estimates represented minimum values.

The sea-survival of smolts from Western Arm Brook in every moratorium year was greater than the pre-moratorium mean (1984-91). However, the sea-survival in some pre-moratorium years was as great or greater than in some moratorium years suggesting that factors other than local commercial fishing mortality play an important role in smolt-to-adult survival.

It is important to note that the moratorium improvements in the status of some salmon stocks in relation to minimum conservation requirements has created the impression that the total population size of salmon has also improved in relation to the long-term abundance. However, this is not the case. Fisheries managers need to keep in mind the fact that the total population size has actually not changed at all but that we have simply increased the number of salmon that now survive to enter the river. The total recruitment of small salmon on Lomond River, Torrent River and Western Arm Brook in moratorium years was actually less than the mean of pre-moratorium years.

The recruitment of small salmon to these rivers in 1997 is anticipated to be comparable to other moratorium years. The anticipated recruitment in 1997 was based on fixed parameters (smolt age composition and commercial and recreational exploitation rates) and the assumption that natural survival rates will remain constant in both the freshwater and marine environments. The use of constants in the prediction of adult returns entails risk since these parameters are subject to annual variability (O'Connell et al., MS 1996).

In contrast to the other two rivers, the recruitment on Torrent River has shown an increasing trend since the 1970s. This is due to the successful colonization of the river above the fishway with adult salmon transferred from Western Arm Brook in 1972-76 combined with a relatively high survival of juvenile salmon in the freshwater environment.

Whether or not the commercial salmon moratorium will be effective in restoring salmon stocks to historic levels will not be known until 1997 and beyond. Returns of adult salmon (i.e. age 3 smolts) to SFA 14(A) rivers in 1997 will belong to the first year-class produced since the commercial salmon fishery moratorium in 1992.

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Table 1. Mean fork length, weight and sex composition of small and large female Atlantic salmon from Lomond River.
Note: Sex is from internal examination for small and internal and external examination for large salmon.

		FORK LENGTH (cm)					WHOLE WEIGHT (kg)					WHOLE WEIGHT FEMALES (kg)					NO.	PERCENT FEMALE	
		N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	SEXED	N	%
LARGE	YY																		
	78	3	69.17	68.0	70.0	1.04	3	3.33	3.2	3.6	0.23	2	3.40	3.2	3.6	0.28	3	2	66.7
	79	1	69.90	69.9	69.9	.	1	3.50	3.5	3.5	.	1	3.50	3.5	3.5	.	1	1	100.0
	80	3	67.90	64.0	71.1	3.60	3	3.74	2.9	4.2	0.69	3	3.74	2.9	4.2	0.69	3	3	100.0
	81	1	75.80	75.8	75.8	.	1	4.80	4.8	4.8	.	0	.	.	.	.	1	0	.
	82	2	70.00	70.0	70.0	0.00	3	3.78	3.6	4.1	0.26	3	3.78	3.6	4.1	0.26	3	3	100.0
	84	4	70.88	66.0	74.0	3.57	4	3.78	3.2	4.2	0.46	2	3.70	3.2	4.2	0.71	2	2	100.0
	86	0	.	.	.	.	5	3.86	3.5	4.5	0.42	0	.	.	.	.	0	0	.
	92	26	70.51	63.0	77.0	3.36	0	.	.	.	.	0	.	.	.	.	26	1	3.8
	93	7	69.71	66.0	74.0	2.98	6	3.54	2.8	4.3	0.62	5	3.45	2.8	4.3	0.65	7	6	85.7
	94	1	76.80	76.8	76.8	.	1	5.20	5.2	5.2	.	1	5.20	5.2	5.2	.	1	1	100.0
	PRE-M	4	70.88	66.0	74.0	3.57	9	3.82	3.2	4.5	0.41	2	3.70	3.2	4.2	0.71	2	2	100.0
	MORAT.	34	70.53	63.0	77.0	3.39	7	3.78	2.8	5.2	0.85	6	3.74	2.8	5.2	0.92	34	8	23.5
	Total	48	70.38	63.0	77.0	3.26	27	3.77	2.8	5.2	0.57	17	3.69	2.8	5.2	0.62	47	19	40.4
SMALL	YY																		
	75	1	50.80	50.8	50.8	.	1	1.40	1.4	1.4	.	0	.	.	.	.	0	0	.
	78	21	51.25	45.5	60.0	3.26	21	1.47	1.0	2.3	0.27	0	.	.	.	.	0	0	.
	79	30	51.97	41.9	57.2	2.81	39	1.47	1.0	2.0	0.22	0	.	.	.	.	0	0	.
	80	15	51.53	46.0	56.0	3.02	13	1.54	1.1	1.8	0.24	0	.	.	.	.	0	0	.
	81	39	51.50	41.0	62.4	3.50	38	1.70	1.3	2.8	0.32	0	.	.	.	.	0	0	.
	82	5	48.80	45.0	52.0	2.77	34	1.49	1.0	2.0	0.21	0	.	.	.	.	0	0	.
	83	15	52.63	44.0	56.0	3.18	11	1.47	1.3	1.7	0.11	8	1.46	1.3	1.6	0.09	12	9	75.0
	84	53	51.09	46.0	58.0	2.80	49	1.45	1.1	1.8	0.20	31	1.43	1.1	1.8	0.16	52	32	61.5
	85	33	51.81	44.0	60.0	3.69	23	1.54	1.1	2.1	0.25	6	1.43	1.2	2.0	0.29	11	9	81.8
	86	40	52.86	45.0	60.0	3.20	49	1.68	0.5	5.3	0.78	9	1.71	1.3	2.2	0.30	37	15	40.5
	88	6	52.92	50.5	56.0	1.80	6	1.50	1.3	1.6	0.15	1	1.36	1.4	1.4	.	6	1	16.7
	90	1	50.80	50.8	50.8	.	1	1.10	1.1	1.1	.	1	1.10	1.1	1.1	.	1	1	100.0
	91	1	54.60	54.6	54.6	.	1	1.30	1.3	1.3	.	1	1.30	1.3	1.3	.	1	1	100.0
	92	52	53.95	37.0	62.5	4.46	4	1.53	1.3	1.8	0.22	3	1.60	1.4	1.8	0.20	6	5	83.3
	93	79	52.86	40.0	61.2	3.89	58	1.61	0.6	3.0	0.48	8	1.46	0.7	2.0	0.40	35	24	68.6
	94	24	52.97	40.6	57.2	3.77	24	1.49	0.5	2.4	0.36	12	1.50	0.5	2.4	0.46	26	14	53.8
	95	21	53.95	48.2	59.0	2.47	34	1.62	0.8	2.5	0.37	5	1.89	1.5	2.1	0.24	9	5	55.6
	96	64	52.43	40.0	61.0	3.45	22	1.50	1.0	2.0	0.35	3	1.63	1.4	2.0	0.32	8	4	50.0
	PRE-M	134	51.90	44.0	60.0	3.18	129	1.55	0.5	5.3	0.51	49	1.47	1.1	2.2	0.24	108	59	54.6
	MORAT.	240	53.09	37.0	62.5	3.82	142	1.57	0.5	3.0	0.41	31	1.57	0.5	2.4	0.39	84	52	61.9
	Total	500	52.39	37.0	62.5	3.56	428	1.55	0.5	5.3	0.40	88	1.50	0.5	2.4	0.30	204	120	58.8

Table 2. Mean fork length, weight and sex composition of small and large female Atlantic salmon from Torrent River.
Note: Sex is from internal examination for small and internal and external examination for large salmon.

		FORK LENGTH (cm)					WHOLE WEIGHT (kg)					WHOLE WEIGHT FEMALES (kg)					NO.	PERCENT FEMALE	
		N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	SEXED	N	%
LARGE	YY																		
	75	0	.	.	.	.	1	4.09	4.1	4.1	.	1	4.09	4.1	4.1	.	1	1	100.0
	80	1	73.60	73.6	73.6	.	0	.	.	.	.	0	.	.	.	.	1	0	.
	85	5	73.80	71.0	76.0	2.17	1	4.25	4.3	4.3	.	1	4.25	4.3	4.3	.	5	2	40.0
	86	9	72.02	64.0	76.0	3.44	9	4.31	2.2	5.5	0.93	5	3.86	2.2	4.7	1.00	9	5	55.6
	87	8	75.18	63.0	87.0	7.85	8	4.10	3.0	5.5	0.96	4	4.45	3.8	5.0	0.64	8	4	50.0
	88	10	70.06	63.0	77.8	5.92	10	3.60	2.3	5.0	1.06	4	4.44	3.5	5.0	0.72	10	4	40.0
	89	15	73.02	65.6	82.4	5.77	8	3.76	2.8	5.3	1.00	4	4.40	3.1	5.3	1.01	15	6	40.0
	90	2	63.50	63.0	64.0	0.71	0	.	.	.	.	0	.	.	.	.	2	1	50.0
	92	1	78.00	78.0	78.0	.	0	.	.	.	.	0	.	.	.	.	1	1	100.0
	93	146	69.51	63.0	81.5	4.77	0	.	.	.	.	0	.	.	.	.	146	104	71.2
	94	3	71.00	70.0	72.0	1.00	2	3.65	3.5	3.8	0.21	1	3.80	3.8	3.8	.	3	1	33.3
	96	2	77.00	72.0	82.0	7.07	2	4.75	3.5	6.0	1.77	2	4.75	3.5	6.0	1.77	2	2	100.0
	PRE-M	49	72.28	63.0	87.0	5.81	36	3.94	2.2	5.5	0.98	18	4.26	2.2	5.3	0.81	49	22	44.9
	MORAT.	152	69.69	63.0	82.0	4.84	4	4.20	3.5	6.0	1.21	3	4.43	3.5	6.0	1.37	152	108	71.1
	Total	202	70.34	63.0	87.0	5.19	41	3.97	2.2	6.0	0.98	22	4.28	2.2	6.0	0.84	203	131	64.5
SMALL	YY																		
	75	0	.	.	.	.	15	1.54	1.1	2.3	0.26	0	.	.	.	.	0	0	.
	79	4	56.38	47.0	62.0	6.57	3	1.82	1.2	2.2	0.58	0	.	.	.	.	0	0	.
	80	58	53.15	32.4	61.0	4.24	0	.	.	.	.	0	.	.	.	.	0	0	.
	81	0	.	.	.	.	10	1.53	1.0	2.0	0.34	0	.	.	.	.	0	0	.
	83	16	53.01	48.5	56.0	2.38	16	1.43	1.0	1.8	0.25	8	1.43	1.0	1.6	0.27	12	8	66.7
	85	154	52.49	44.0	61.5	3.16	6	1.46	1.0	2.3	0.46	0	.	.	.	.	7	3	42.9
	86	305	52.39	40.5	61.5	3.30	303	1.76	0.5	3.0	0.43	16	1.52	1.2	2.0	0.22	24	18	75.0
	87	301	51.96	42.7	60.5	2.86	301	1.57	0.7	2.8	0.38	19	1.44	1.0	2.0	0.25	21	19	90.5
	88	220	53.67	47.0	62.7	3.37	220	1.52	1.0	2.5	0.36	12	1.56	1.0	2.3	0.34	14	12	85.7
	89	108	54.12	45.9	62.0	3.47	101	1.67	0.2	2.6	0.32	0	.	.	.	.	0	0	.
	90	40	53.93	47.0	62.5	3.84	0	.	.	.	.	0	.	.	.	.	5	3	60.0
	91	43	52.61	47.0	59.0	3.10	4	1.78	1.5	2.2	0.31	2	1.90	1.6	2.2	0.42	4	2	50.0
	92	17	53.43	46.7	59.0	3.03	0	.	.	.	.	0	.	.	.	.	4	3	75.0
	93	254	53.18	30.0	62.0	4.20	2	2.10	1.9	2.3	0.28	2	2.10	1.9	2.3	0.28	2	2	100.0
	94	22	54.25	48.0	60.5	3.38	17	1.43	0.9	3.0	0.50	2	1.50	1.4	1.6	0.14	2	2	100.0
	95	19	54.07	48.3	58.4	2.58	17	1.68	1.1	2.1	0.32	10	1.68	1.4	2.0	0.21	17	12	70.6
	96	37	54.22	48.0	60.8	3.09	34	1.57	1.0	2.8	0.37	4	1.71	1.3	2.3	0.45	7	6	85.7
	PRE-M	1171	52.75	40.5	62.7	3.30	935	1.63	0.2	3.0	0.40	49	1.51	1.0	2.3	0.28	75	57	76.0
	MORAT.	349	53.42	30.0	62.0	3.93	70	1.58	0.9	3.0	0.41	18	1.71	1.3	2.3	0.30	32	25	78.1
	Total	1598	52.92	30.0	62.7	3.49	1049	1.62	0.2	3.0	0.40	75	1.55	1.0	2.3	0.30	119	90	75.6

Table 3. Mean fork length, weight and sex composition of small and large female Atlantic salmon from Western Arm Brook.
Note: Sex is determined from internal examination for small and internal and external examination for large salmon.

		FORK LENGTH (cm)					WHOLE WEIGHT (kg)					WHOLE WEIGHT FEMALES (kg)					NO.	PERCENT FEMALE	
		N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	SEXED	N	%
LARGE	YY																		
	73	2	72.00	72.0	72.0	0.00	2	3.85	3.9	3.9	0.00	0	.	.	.	.	2	0	.
	77	2	74.50	74.0	75.0	0.71	2	3.94	3.9	4.0	0.08	1	3.88	3.9	3.9	.	2	1	50.0
	80	3	71.70	65.1	77.0	6.06	3	3.33	0.9	4.9	2.14	3	3.33	0.9	4.9	2.14	3	3	100.0
	81	2	69.00	68.5	69.5	0.71	2	2.95	2.3	3.6	0.92	2	2.95	2.3	3.6	0.92	2	2	100.0
	85	1	71.00	71.0	71.0	.	1	3.50	3.5	3.5	.	0	.	.	.	.	1	0	.
	87	1	64.00	64.0	64.0	.	1	2.40	2.4	2.4	.	1	2.40	2.4	2.4	.	1	1	100.0
	88	2	76.00	72.0	80.0	5.66	2	3.40	2.8	4.0	0.85	2	3.40	2.8	4.0	0.85	2	2	100.0
	89	1	63.50	63.5	63.5	.	1	1.60	1.6	1.6	.	0	.	.	.	.	1	0	.
	90	1	64.80	64.8	64.8	.	1	3.00	3.0	3.0	.	1	3.00	3.0	3.0	.	1	1	100.0
	91	1	76.20	76.2	76.2	.	1	4.00	4.0	4.0	.	1	4.00	4.0	4.0	.	1	1	100.0
	92	8	70.85	63.0	79.0	5.73	1	4.50	4.5	4.5	.	1	4.50	4.5	4.5	.	8	5	62.5
	93	4	69.58	67.8	71.5	1.95	4	3.48	2.0	4.2	1.00	4	3.48	2.0	4.2	1.00	4	4	100.0
	94	7	70.11	63.9	78.1	4.68	7	3.67	2.2	5.0	1.00	3	3.83	2.2	5.0	1.46	7	3	42.9
	95	35	73.88	64.8	83.5	3.95	35	4.73	3.0	6.3	0.84	29	4.72	3.0	6.0	0.80	35	29	82.9
	96	26	72.35	63.0	77.4	4.09	26	3.94	1.2	6.0	1.54	21	3.89	1.2	6.0	1.52	26	21	80.8
	PRE-M	7	70.21	63.5	80.0	6.43	7	3.04	1.6	4.0	0.88	5	3.24	2.4	4.0	0.73	7	5	71.4
	MORAT.	80	72.53	63.0	83.5	4.33	73	4.27	1.2	6.3	1.22	58	4.28	1.2	6.0	1.21	80	62	77.5
	Total	96	72.29	63.0	83.5	4.44	89	4.10	0.9	6.3	1.25	69	4.12	0.9	6.0	1.25	96	73	76.0
SMALL	YY																		
	.	1	52.70	52.7	52.7	.	0	.	.	.	.	0	.	.	.	.	0	0	.
	71	158	52.88	36.6	61.2	2.82	31	1.54	1.0	2.3	0.24	7	1.55	1.4	1.8	0.15	11	9	81.8
	72	132	52.38	37.2	62.5	3.59	149	1.62	0.6	2.6	0.37	17	1.55	1.2	2.3	0.25	25	17	68.0
	73	272	53.04	43.8	62.1	2.92	271	1.59	0.8	2.8	0.28	91	1.56	0.9	2.3	0.24	116	92	79.3
	74	163	53.09	45.9	59.8	2.55	161	1.62	1.1	2.2	0.23	58	1.62	1.1	2.2	0.22	71	59	83.1
	75	42	52.80	33.0	58.5	4.50	42	1.59	0.7	2.3	0.33	10	1.72	1.1	2.3	0.33	18	10	55.6
	76	216	53.12	41.0	59.0	2.84	22	1.61	1.4	3.0	0.34	8	1.48	1.4	1.6	0.11	11	8	72.7
	77	155	52.88	40.9	60.3	3.55	147	1.39	0.5	2.6	0.39	1	1.58	1.6	1.6	.	3	1	33.3
	78	157	52.25	45.0	59.0	2.84	63	1.27	0.5	2.1	0.40	17	1.48	1.2	1.9	0.19	20	18	90.0
	79	486	51.45	27.5	62.0	3.01	486	1.51	0.5	2.9	0.30	0	.	.	.	.	0	0	.
	80	1579	52.54	19.8	59.5	2.55	1564	0.96	0.1	7.0	0.35	2	2.30	1.7	2.9	0.85	2	2	100.0
	81	162	52.35	43.0	61.0	3.12	162	1.55	0.8	2.9	0.36	14	1.64	1.4	2.0	0.15	16	14	87.5
	82	141	53.11	48.0	59.5	2.12	141	1.82	0.7	3.0	0.34	0	.	.	.	.	0	0	.
	83	205	51.42	35.9	60.0	2.90	203	1.52	0.7	2.7	0.31	1	1.80	1.8	1.8	.	1	1	100.0
	84	41	51.14	45.0	59.5	2.71	39	1.27	0.8	2.0	0.33	2	1.30	1.2	1.4	0.14	2	2	100.0
	85	80	52.27	37.5	59.0	3.04	80	1.56	0.9	2.2	0.30	45	1.58	0.9	2.1	0.30	52	45	86.5
	86	38	52.93	46.0	58.5	2.95	38	1.65	1.1	2.2	0.29	0	.	.	.	.	0	0	.
	87	85	53.79	47.0	59.4	2.69	85	1.63	0.5	2.7	0.34	17	1.91	1.5	2.7	0.41	22	18	81.8
	88	69	53.50	36.5	61.0	3.81	66	1.54	0.5	2.4	0.48	18	1.53	0.9	2.0	0.33	27	21	77.8
	89	155	53.51	42.0	60.5	3.17	58	1.60	0.0	2.5	0.51	7	1.89	1.5	2.3	0.28	8	7	87.5
	90	49	55.45	50.8	62.2	3.16	36	1.82	1.0	2.4	0.41	2	1.40	1.4	1.4	0.00	3	2	66.7
	91	228	53.26	46.4	62.2	2.50	81	1.71	0.0	2.1	0.25	0	.	.	.	.	0	0	.
	92	415	53.65	34.0	61.6	2.91	7	1.61	0.7	2.2	0.64	0	.	.	.	.	0	0	.
	93	292	54.02	46.6	62.0	2.74	271	1.82	0.6	4.1	0.53	0	.	.	.	.	0	0	.
	94	111	53.74	36.5	60.9	3.37	109	1.79	0.9	2.8	0.35	11	1.80	1.3	2.3	0.29	11	11	100.0
	95	99	54.50	45.8	62.0	2.78	94	2.10	1.3	3.3	0.36	18	1.99	1.5	2.5	0.28	25	24	96.0
	96	82	54.70	45.0	61.7	3.42	78	1.95	0.8	3.0	0.48	29	2.04	1.3	2.7	0.37	36	29	80.6
	PRE-M	745	53.30	36.5	62.2	3.05	483	1.60	0.0	2.7	0.39	91	1.64	0.9	2.7	0.36	114	95	83.3
	MORAT.	999	53.94	34.0	62.0	2.97	559	1.88	0.6	4.1	0.48	58	1.98	1.3	2.7	0.34	72	64	88.9
	Total	5613	52.83	19.8	62.5	2.97	4484	1.39	0.0	7.0	0.49	375	1.66	0.9	2.9	0.32	480	390	81.3

Table 4. Counts of small and large Atlantic salmon at Lomond River and Torrent River fishways and Western Arm Brook counting fence (SFA 14A), 1974-96. Numbers in bold are partial counts.

	Lomond River		Torrent River		Western Arm Brook		
					Unadjusted	Adjusted	
Year	Small	Large	Small	Large	Small	Small	Large
1974	41	33	38	3	382	.	4
1975	1	0	191	25	631	.	1
1976	132	11	341	47	520	.	0
1977	192	11	789	33	362	.	3
1978	117	12	971	21	293	.	1
1979	195	1	1984	39	1578	.	0
1980	301	19	792	63	435	.	3
1981	110	50	2101	97	451	.	1
1982	275	16	2112	523	394	.	3
1983	220	7	2007	442	1141	.	4
1984	440	47	1805	288	120	.	0
1985	190	14	1553	30	**165**	416	1
1986	354	32	2815	92	**252**	525	0
1987	355	11	2505	68	378	.	1
1988	437	21	2075	44	**102**	251	1
1989	**382**	**21**	1369	60	**414**	455	0
1990	**391**	**18**	2296	82	**124**	444	0
1991	**403**	**20**	1441	71	233	.	1
1992	435	80	2347	169	480	.	8
1993	526	34	4009	222	947	.	8
1994	701	50	3592	331	954	.	31
1995	1003	95	5800	611	823	.	33
1996	601	93	6923	507	1230	.	50
Mean (92-95)	666	65	3937	333	801	.	20
95% CL=+/-	398	44	2273	314	354	.	22
CV	37.5	42.9	36.3	59.1	27.8	.	69.4
N	4	4	4	4	4	.	4
Mean (84-91)	369	23	1982	92	224	.	1
95% CL=+/-	66	10	442	68	100	.	0
CV	21.5	49.9	26.7	88.9	53.4	.	106.9
N	8	8	8	8	8	.	8

Note: Western Arm Brook small salmon counts in some years were adjusted to account for fish that did not move upstream until after the counting fence was removed:

1. small salmon counts in 1985-86 were adjusted based on the ratio of marked to unmarked small at the counting fence (Claytor and Mullins, 1988).
2. small salmon count in 1988 was adjusted based on kelt counts in 1989.
3. small salmon count in 1989 was adjusted based on the proportion of marked kelts (131/144) recaptured in 1990.
4. small salmon count in 1990 was adjusted based on the proportion of marked kelts (43/154) recaptured in 1991.

Table 5. Sea-survival of Atlantic salmon smolts from Western Arm Brook, 1971-96.

Year (i)	Smolts Year (i)	Small Returns Year (i+1)	% Virgin 1SW	V. 1SW Returns Year (i+1)	% Sea-Survival
1971	5735	406	95.9	389	6.8
1972	11905	797	99.6	794	6.7
1973	8484	506	100.0	506	6.0
1974	11854	639	100.0	639	5.4
1975	9600	552	100.0	552	5.8
1976	6232	373	100.0	373	6.0
1977	9899	315	97.7	308	3.1
1978	13071	1578	99.6	1572	12.0
1979	8349	465	100.0	465	5.6
1980	15665	492	97.0	477	3.0
1981	13981	467	100.0	467	3.3
1982	12477	1141	99.5	1135	9.1
1983	10552	235	100.0	235	2.2
1984	20653	467	98.8	462	2.2
1985	13417	527	100.0	527	3.9
1986	17719	437	100.0	437	2.5
1987	17029	422	84.1	355	2.1
1988	15321	455	100.0	455	3.0
1989	11407	444	97.9	435	3.8
1990	10563	233	100.0	233	2.2
1991	13453	480	99.8	479	3.6
1992	15405	947	86.3	817	5.3
1993	13435	954	96.3	919	6.8
1994	9283	823	100.0	823	8.9
1995	15144	1230	100.0	1230	8.1
1996	14502	.	.	.	.
Mean (92-95)	13317	989	95.7	947	7.3
95% CI +/-	4499	273	10.3	309	2.5
C.V.	21.2	17.4	6.8	20.5	21.4
N	4	4	4	4	4
Mean (84-91)	14945	433	98	423	3
95% CI +/-	2845	73	5	76	1
C.V.	22.8	20.1	5.6	21.4	26.3
N	8	8	8	8	8

Table 6. Estimation of spawner requirements for the Lomond River.

Fluvial Rearing Units:		2,156 (100 sq. m)	(stream survey, 1993)
Lacustrine Area:		1,570 ha	(topographic maps)
Optimal Egg Deposition:		240 eggs/unit	(Elson, 1957)
		368 eggs/ha	(O'Connell et al., 1991)
Fecundity:		1,783 eggs/kg	(Chadwick et al., 1986)
Small -	% overall	96.0 (816/854)	(1993 values)
	% female	61.9 (n=84)	(Mean, 1992-1996)
	mean wt	1.57 kg (n=31)	(Mean, 1992-1996)
Large -	% overall	4.0 (38/854)	(1993 values)
	% female	85.7 (n=15)	(Mean, 1992-1996)
	mean wt	3.69 kg (n=17)	(Mean, 1992-1996)
Egg Deposition Requirement::		1,095,200 (eggs)	
Eggs per spawner:		1,889 (eggs)	
Total Spawners Required:		580 (Small + Large)	

	total
Small	557
Large	23
Total	580

Table 7. Estimation of spawner requirements for the Torrent River.

Fluvial Rearing Units:	5,168 (100 sq. m)	(Traverse, 1971)
Lacustrine Area:	2,323 ha	(topographic maps)
Optimal Egg Deposition:	240 eggs/unit	(Elson, 1957)
	105 eggs/ha	(O'Connell et al., 1991)
Fecundity:	1,783 eggs/kg	(Chadwick et al., 1986)
Small - % overall	95.0 (4,215/4,439)	(1993 values)
% female	78.1 (n=32)	(Mean, 1992-1996)
mean wt	1.71 (n=18)	(Mean, 1992-1996)
Large - % overall	5.0 (224/4,439)	(1993 values)
% female	64.5 (n=203)	(Mean, 1992-1996)
mean wt	4.28 (n=58)	(Mean, 1992-1996)
Egg Deposition Requirement::	1,484,235 (eggs)	
Eggs per spawner:	2,508 (eggs)	
Total Spawners Required:	592 (Small + Large)	

	total
Small	562
Large	30
Total	592

Table 8. Estimation of spawner requirements for Western Arm Brook.

Fluvial Rearing Units:	2,900 (100 sq. m)	(Traverse, 1971)
Lacustrine Area:	2,017 ha	(topographic maps)
Optimal Egg Deposition:	240 eggs/unit	(Elson, 1957)
	105 eggs/ha	(O'Connell et al., 1991)
Fecundity:	1,783 eggs/kg	(Chadwick et al., 1986)
Small - % overall	99.0 (947/955)	(1993 values)
% female	88.9 (n=72)	(Mean, 1992-1996)
mean wt	1.98 (n=58)	(Mean, 1992-1996)
Large - % overall	1.0 (8/955)	(1993 values)
% female	77.5 (n=80)	(Mean, 1992-1996)
mean wt	4.28 (n=58)	(Mean, 1992-1996)
Egg Deposition Requirement::	907,785 (eggs)	
Eggs per spawner:	3,166 (eggs)	
Total Spawners Required:	287 (Small + Large)	

	total
Small	284
Large	3
Total	287

Table 9. Total returns, spawning escapement, potential egg deposition and percentage of egg deposition requirement achieved on Lomond River, Torrent River and Western Arm Brook in SFA 14A, 1984-96. Numbers in bold type are estimates based on partial counts.

	Total Returns							% Egg
Year	Small	Large	Prop. Large	Small	Large	Small	Large	Requirement Achieved
	Lomond River							
1984	986	75	0.07	440	47	0.7356	0.0758	74
1985	393	14	0.03	189	14	0.3160	0.0226	31
1986	725	37	0.05	353	32	0.5901	0.0516	59
1987	652	12	0.02	355	11	0.5935	0.0177	56
1988	841	24	0.03	437	21	0.7306	0.0339	70
1989	**652**	**22**	0.03	**382**	**21**	**0.6386**	**0.0339**	**61**
1990	777	**19**	0.02	**391**	**18**	**0.6537**	**0.0290**	**62**
1991	**731**	**21**	0.03	**403**	**20**	**0.6737**	**0.0323**	**64**
1992	794	86	0.10	419	80	0.9495	0.3728	121
1993	816	38	0.04	504	33	1.2714	0.1538	118
1994	1038	56	0.05	695	49	1.5115	0.2793	142
1995	1365	101	0.07	983	95	1.0414	0.5415	187
1996	982	98	0.09	601	93	1.0431	0.5244	143
	Torrent River							
1984	1,805	288	0.14	1,805	288	3.0902	0.9118	270
1985	1,623	30	0.02	1,551	30	2.3022	0.0909	161
1986	3,155	93	0.03	2,815	92	4.9539	0.3913	360
1987	2,670	68	0.02	2,482	68	2.7027	0.2486	199
1988	2,388	44	0.02	2,075	44	3.8292	0.1130	266
1989	1,512	60	0.04	1,367	60	3.1478	0.1874	225
1990	2,518	82	0.03	2,296	82	3.0851	0.1993	221
1991	1,591	71	0.04	1,440	71	2.4155	0.2295	178
1992	2,832	170	0.06	2,344	169	4.1125	0.5364	313
1993	4,215	224	0.05	4,009	222	7.2739	0.7046	538
1994	3,827	332	0.08	3,592	331	6.2796	1.5815	530
1995	6,168	615	0.09	5,800	611	12.4117	2.9193	1033
1996	7,371	509	0.06	6,923	507	16.4851	2.4955	1279
	Western Arm Brook							
1984	235	0	0.00	117	0	0.2746	0.0000	30
1985	467	1	0.00	416	1	0.7202	0.0017	80
1986	527	0	0.00	525	0	1.4194	0.0000	156
1987	437	1	0.00	378	1	0.9297	0.0025	103
1988	422	1	0.00	251	1	0.6051	0.0024	67
1989	455	0	0.00	455	0	1.2907	0.0000	142
1990	444	0	0.00	444	0	1.4276	0.0000	157
1991	233	1	0.00	233	1	0.6129	0.0026	68
1992	480	8	0.02	480	8	1.3454	0.0224	151
1993	947	8	0.01	947	8	2.5943	0.0219	288
1994	954	31	0.03	954	31	2.5321	0.1187	292
1995	823	33	0.04	796	30	2.3844	0.2122	286
1996	1,230	50	0.04	1189	48	3.4858	0.2839	415

Notes:

1. Lomond egg depositions in 1984-88 is based on 1983-93 mean biological characteristics and 1992-93 based on 1993 values.
2. Torrent egg depositions in 1990-93 based on 1985-89 mean biological characteristics for 1985-89 for small and large salmon.
3. Western Arm Brook egg depositions in 1984 based on 1974-93 mean biological characteristics for small and large salmon.

Table 10. Estimation of stock size for Lomond River, Nfld. salmon stocks. Values in bold/italics are estimated based on the previous three year mean.

Spawning Year (i)	Recruit Years (i+4)	(i+5)	(i+6)	River Escapement Year i	Adj. Escapement Year i	Total Recruits Year i	Spawning Escapement Small	Recruits at Smolt Age 2+ (i+4)	3+ (i+5)	4+ (i+6)	Total	Recruits/spawners (R/S ratio) 2+	3+	4+	Total	R/S ratio Rec. Yr.	Smolt Distribution 2+	3+	4
71	75	76	77	60	58	146	6	82	1542	100	1725	13.6644	257.0630	16.7285	287.4558	63.9089	13.0	81.0	6.0
72	76	77	78	283	276	689	30	248	1355	67	1670	8.2514	45.1668	2.2499	55.6682	14.2542	13.0	81.0	6.0
73	77	78	79	394	384	959	108	217	911	63	1192	2.0136	8.4373	0.5817	11.0326	.	13.0	81.0	6.0
74	78	79	80	365	356	889	41	146	848	87	1081	3.5670	20.6856	2.1167	26.3693	.	13.0	81.0	6.0
75	79	80	81	259	252	631	1	136	1172	90	1398	136.1165	1171.576	90.1437	1397.836	.	13.0	81.0	6.0
76	80	81	82	782	762	1904	132	188	1217	85	1490	1.4245	9.2192	0.6453	11.2890	8.2116	13.0	81.0	6.0
77	81	82	83	687	669	1673	192	195	1150	69	1414	1.0172	5.9890	0.3584	7.3646	9.0630	13.0	81.0	6.0
78	82	83	84	462	450	1125	117	185	929	144	1258	1.5773	7.9400	1.2312	10.7485	12.2412	13.0	81.0	6.0
79	83	84	85	430	419	1047	195	149	1945	57	2151	0.7646	9.9730	0.2944	11.0320	4.0006	13.0	81.0	6.0
80	84	85	86	594	579	1446	301	312	775	106	1193	1.0369	2.5752	0.3519	3.9640	14.1860	13.0	81.0	6.0
81	85	86	87	617	601	1502	110	124	1430	95	1650	1.1309	12.9996	0.8660	14.9965	6.4804	13.0	81.0	6.0
82	86	87	88	583	568	1420	275	229	1286	123	1638	0.8345	4.6763	0.4468	5.9576	8.5916	13.0	81.0	6.0
83	87	88	89	471	459	1147	220	206	1659	95	1960	0.9381	7.5398	0.4330	8.9109	4.4477	13.0	81.0	6.0
84	88	89	90	986	960	2401	440	266	1286	114	1666	0.6050	2.9227	0.2581	3.7858	9.0672	13.0	81.0	6.0
85	89	90	91	393	383	957	189	206	1533	107	1846	1.0920	8.1120	0.5654	9.7695	5.3045	13.0	81.0	6.0
86	90	91	92	725	706	1765	353	246	1443	46	1735	0.6971	4.0869	0.1309	4.9148	2.1173	13.0	81.0	6.0
87	91	92	93	652	635	1588	355	232	624	47	903	0.6522	1.7573	0.1337	2.5432	1.8694	13.0	81.0	6.0
88	92	93	94	841	819	2048	437	100	641	60	801	0.2291	1.4662	**0.1382**	1.8335	2.6086	13.0	81.0	6.0
89	93	94	95	**652**	635	1588	382	103	815	79	998	0.2694	**2.1360**	**0.2081**	2.6136	3.3763	13.0	81.0	6.0
90	94	95	96	**777**	757	1893	391	131	1072	57	1260	**0.3344**	**2.7414**	**0.1461**	3.2219	2.3545	13.0	81.0	6.0
91	95	96	97	**731**	712	1781	403	172	771			**0.4268**	**1.9129**				13.0	81.0	6.0
92	96	97		794	770	770	419	124				**0.2955**					13.0	81.0	6.0
93	97			816	791	791	504												
94				1038	1006	1006	695												
95				1365	1324	1324	983												
96				982	952	952	601												
97																			

Anticipated Returns in 1997 (based on the average R/S in 1994-1996)

	R/S Ratio 2+	3+	4+	No. of Small 2+	3+	4+	Total
Mean	0.352	2.263	0.164	178	948	66	1192
Hi	0.427	2.741	0.208	215	1149	84	1448
Low	0.296	1.913	0.138	149	802	56	1006

Estimate of Precision: Observed-Expected returns in 1992-96.
Comparison in 92-95 based on R/S ratio in 1992-1994.

Recruit Year	No. Small Obs.	Exp.	Difference Obs-Exp.	(%)
92	770	803	-33	-4
93	791	934	-143	-15
94	1006	849	157	19
95	1324	862	462	54
96	952	1059	-107	-10
Mean				9

Table 11. Estimation of stock size for Torrent River, Nfld. salmon stocks.
Note: Spawning escapement for 1972-76 includes fish transferred fron Western Arm Brook (104, 204, 100, 238, 100).

Spawning Year (i)	Recruit Years (i+5)	(i+6)	River Escapement Year i	Adj. Escapement Year i	Total Recruits Year i	Spawning Escapement Small	Recruits at Smolt Age 3+ (i+5)	4+ (i+6)	Total	Recruits/spawners (R/S ratio) 3+	4+	Total	R/S ratio Rec. Yr.	% Smolt Distribution 3+	4+
71	76	77	107	100	249	54	627	386	1013	11.6112	7.1415	18.7528	10.2432	79	21
72	77	78	86	80	200	120	1451	490	1941	12.0896	4.0813	16.1709	34.4863	79	21
73	78	79	184	171	428	299	1842	1001	2844	6.1619	3.3495	9.5114	6.8039	79	21
74	79	80	96	89	223	121	3768	387	4155	31.1368	3.1993	34.3360	12.2002	79	21
75	80	81	314	292	731	404	1456	1109	2565	3.6046	2.7439	6.3485	7.9399	79	21
76	81	82	341	317	794	441	4170	1124	5294	9.4563	2.5481	12.0044	5.2582	79	21
77	82	83	789	735	1836	784	4227	1021	5248	5.3919	1.3024	6.6942	2.5814	79	21
78	83	84	1002	933	2332	971	3841	882	4723	3.9558	0.9086	4.8644	4.1822	79	21
79	84	85	2049	1908	4769	1984	3319	793	4112	1.6728	0.3998	2.0727	4.7156	79	21
80	85	86	792	737	1843	789	2984	1542	4526	3.7823	1.9545	5.7368	2.9457	79	21
81	86	87	2268	2112	5279	2101	5801	1305	7106	2.7612	0.6211	3.3823	2.7404	79	21
82	87	88	2299	2140	5351	2112	4909	1167	6077	2.3245	0.5526	2.8772	1.9085	79	21
83	88	89	2089	1945	4862	2007	4391	739	5130	2.1878	0.3682	2.5560	3.6670	79	21
84	89	90	1805	1680	4201	1805	2780	1231	4011	1.5403	0.6818	2.2221	1.5406	79	21
85	90	91	1623	1511	3778	1551	4630	778	5408	2.9851	0.5014	3.4865	0.9925	79	21
86	91	92	3155	2937	7343	2815	2925	530	3456	1.0392	0.1885	1.2277	1.7495	79	21
87	92	93	2670	2486	6214	2482	1996	790	2785	0.8041	0.3181	1.1222	2.3183	79	21
88	93	94	2388	2223	5558	2075	2970	717	3687	1.4314	**0.3455**	1.7769	2.7383	79	21
89	94	95	1512	1408	3519	1367	2697	1155	3852	**1.9728**	**0.8452**	2.8180	4.2084	79	21
90	95	**96**	2518	2344	5861	2296	4346	1381	5727	**1.8931**	**0.6014**			79	21
91	**96**	**97**	1591	1481	3703	1440	5194		5194	**3.6071**				79	21
92	**97**		2832	2526	2526	2344									
93			4215	3760	3760	4009									
94			3827	3414	3414	3592									
95			6168	5502	5502	5800									
96			7371	6575	6575	6923									
97															

Anticipated Returns in 1997 (based on the average R/S in 1994-1996)

	R/S Ratio 3+	4+	No. of Small 3+	4+	Total
Mean	2.491	0.597	5839	860	6699
Hi	3.607	0.845	8455	1217	9672
Low	1.893	0.345	4437	497	4935

Estimate of Precision: Observed-Expected returns in 1992-96.
Comparison in 92-95 based on R/S ratio in 1992-94.

Recruit Year	No. Small Obs.	Exp.	Difference Obs-Exp	(%)
92	2526	4281	-1755	-41
93	3760	3616	144	4
94	3414	2507	907	36
95	5502	3609	1893	52
96	6575	3697	2878	78
Mean				13

Table 12. Estimation of stock size for Western Arm Brook, Nfld. salmon stocks.

Spawning	Recruit Years			River	Adj.	Total	Spawning	Recruits at Smolt Age				Recruit	Recruits/spawners (R/S ratio)				Smolt Distribution		
Year (i)	(i+5)	(i+6)	(i+7)	Escapement Year i	Escapement Year i	Recruits Year i	Escapement Small	3+ (i+5)	4+ (i+6)	5+ (i+7)	Total	3+	4+	5+	Total	R/S ratio Rec. Yr.	3+	4+	5+
71	76	77	78	632	621	1553	427	543	504	39	1085	1.2708	1.1807	0.0906	2.5421	2.0274	40.0	55.0	5.0
72	77	78	79	406	399	998	309	367	426	194	986	1.1866	1.3779	0.6275	3.1920	8.5381	40.0	55.0	5.0
73	78	79	80	797	783	1959	554	310	2133	57	2500	0.5589	3.8499	0.1031	4.5120	2.6482	40.0	55.0	5.0
74	79	80	81	506	497	1243	382	1551	629	60	2240	4.0607	1.6453	0.1583	5.8642	2.5074	40.0	55.0	5.0
75	80	81	82	639	628	1570	508	457	665	57	1179	0.8998	1.3091	0.1130	2.3218	2.7745	40.0	55.0	5.0
76	81	82	83	552	543	1357	465	484	631	140	1255	1.0401	1.3574	0.3015	2.6990	8.5637	40.0	55.0	5.0
77	82	83	84	373	367	917	352	459	1542	29	2030	1.3042	4.3813	0.0820	5.7674	1.3275	40.0	55.0	5.0
78	83	84	85	315	310	774	289	1122	318	57	1497	3.8810	1.0991	0.1986	5.1786	1.6736	40.0	55.0	5.0
79	84	85	86	1578	1551	3878	1578	231	631	65	927	0.1464	0.4000	0.0410	0.5874	2.8681	40.0	55.0	5.0
80	85	86	87	465	457	1143	427	459	712	54	1225	1.0751	1.6682	0.1258	2.8690	2.5458	40.0	55.0	5.0
81	86	87	88	492	484	1209	447	518	591	52	1161	1.1589	1.3214	0.1160	2.5963	1.9387	40.0	55.0	5.0
82	87	88	89	467	459	1148	391	430	570	56	1056	1.0986	1.4588	0.1430	2.7004	4.5052	40.0	55.0	5.0
83	88	89	90	1141	1122	2804	1140	415	615	55	1084	0.3639	0.5395	0.0479	0.9512	6.2263	40.0	55.0	5.0
84	89	90	91	235	231	578	117	447	600	29	1076	3.8228	5.1292	0.2447	9.1967	1.4380	40.0	55.0	5.0
85	90	91	92	467	459	1148	416	436	315	23	774	1.0492	0.7570	0.0550	1.8612	1.0193	40.0	55.0	5.0
86	91	92	93	527	518	1295	525	229	252	45	526	0.4363	0.4797	0.0860	1.0020	2.8403	40.0	55.0	5.0
87	92	93	94	437	430	1074	378	183	497	46	726	0.4846	1.3145	0.1204	1.9195	2.9148	40.0	55.0	5.0
88	93	94	95	422	415	1037	251	361	501	39	901	1.4397	1.9943	**0.1564**	3.5904	**1.8128**	40.0	55.0	5.0
89	94	95	96	455	447	1118	455	364	432	59	855	0.8001	**0.9491**	**0.1289**	1.8781	**3.5970**	40.0	55.0	5.0
90	95	96	**97**	444	436	1091	444	314	645			0.7073	**1.4536**				40.0	55.0	5.0
91	96	**97**		233	229	573	233	469				2.0145					40.0	55.0	5.0
92	**97**			480	458	458	480												
93				947	903	903	947												
94				954	910	910	954												
95				823	785	785	796												
96				1230	1173	1173	1189												
97																			

Anticipated Returns in 1997 (based on the average R/S in 1994-1996)

	R/S Ratio			No. of Small			
	3+	4+	5+	3+	4+	5+	Total
Mean	1.174	1.466	0.135	564	341	60	965
H	2.014	1.994	0.156	967	465	69	1501
Low	0.707	0.949	0.120	340	221	53	614

Estimate of Precision: Observed-Expected returns in 1992-96.

Comparison in 92-95 based on R/S ratio in 1992-1994.

Recruit	No. Smolt		Difference	
Year	Obs.	Exp.	bs-Exp	(%)
92	458	1043	-585	-56
93	903	751	152	20
94	910	763	147	19
95	785	1000	-215	-21
96	1173	914	259	28
Mean				-9

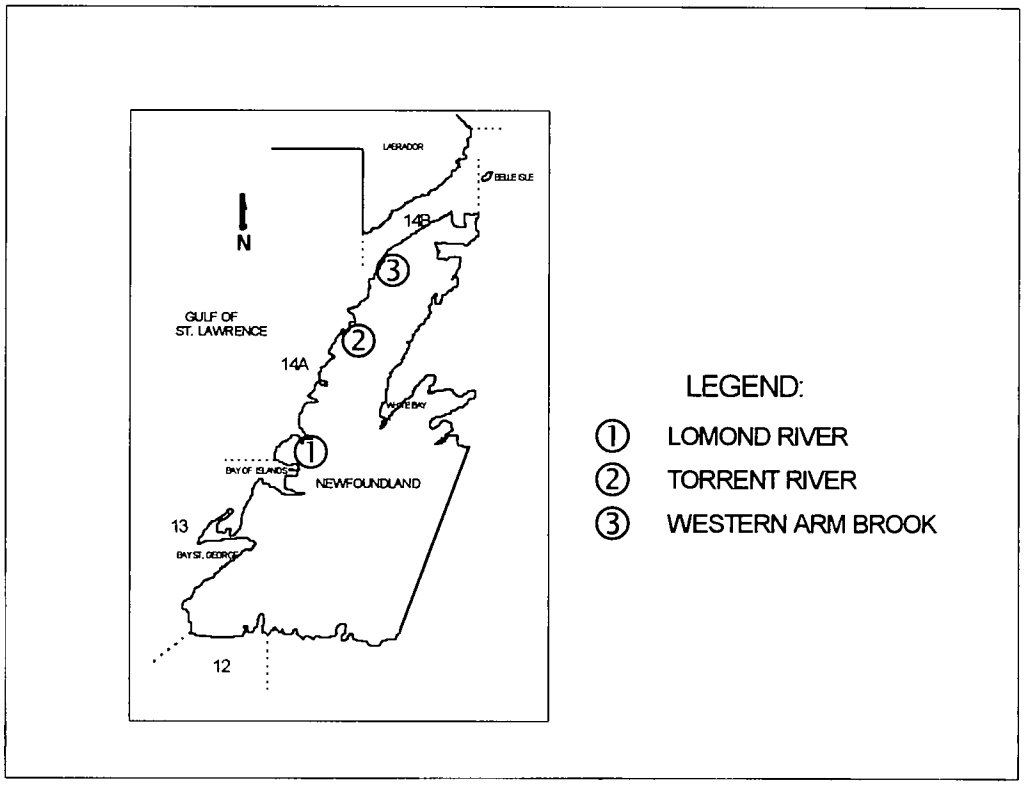


Figure 1. Location of Salmon Fishing Areas (SFAs) and selected rivers in SFA 14A.

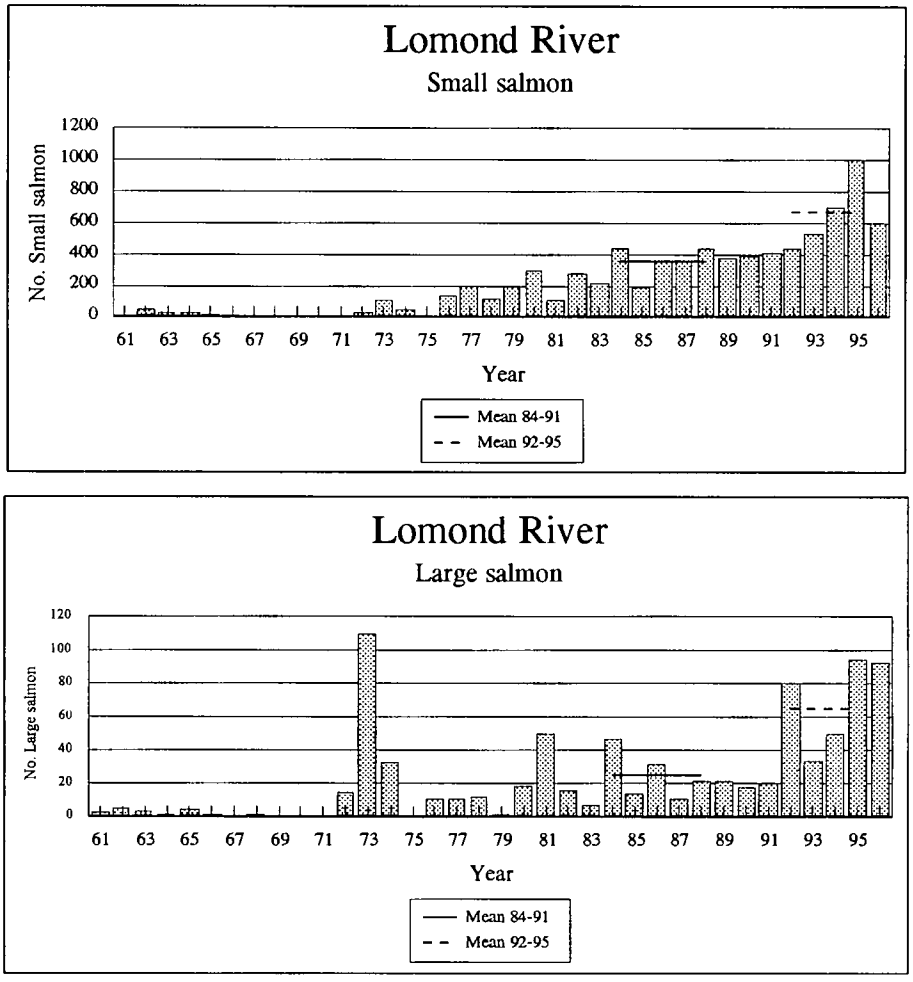


Figure 2. Counts of small and large Atlantic salmon at the Lomond River fishway, 1961-96.

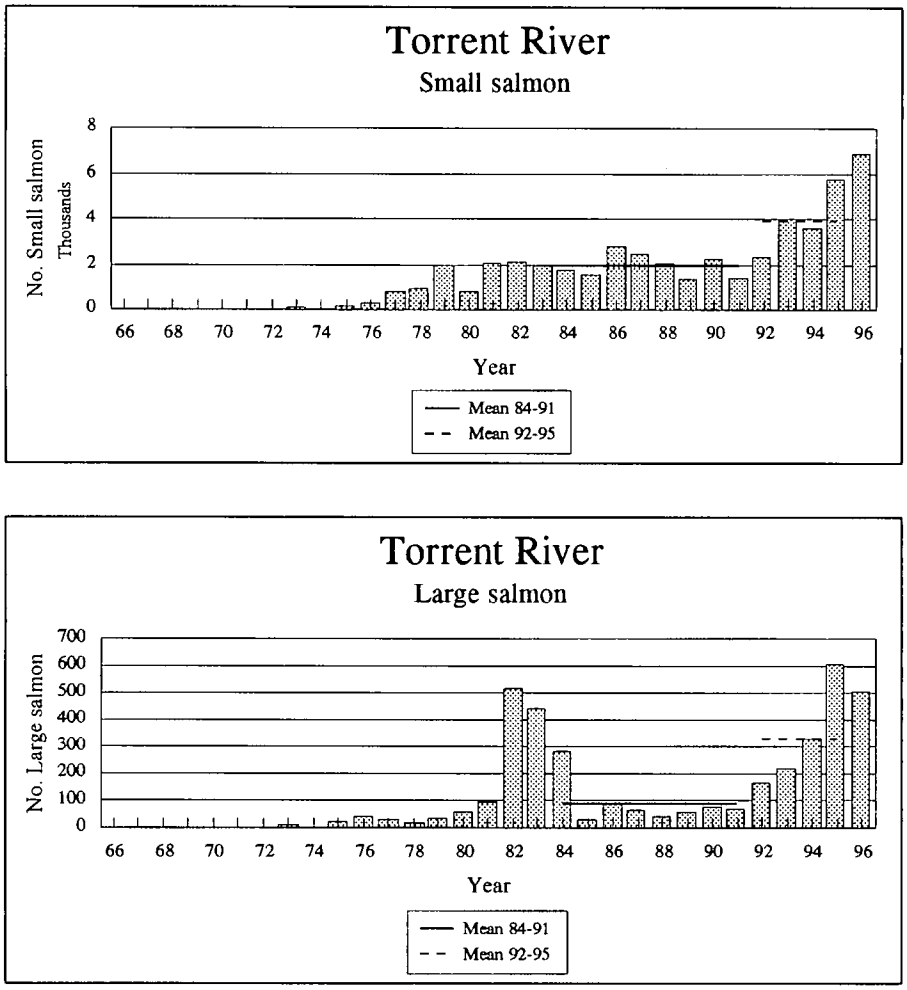
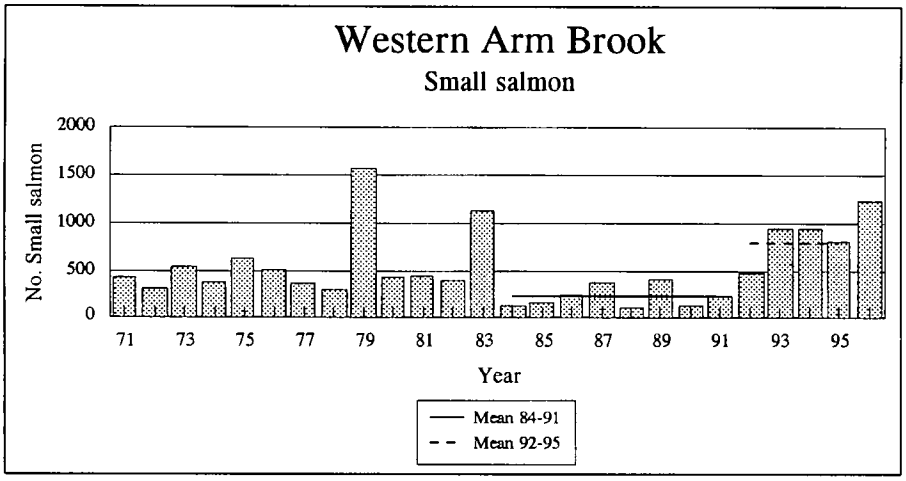


Figure 3. Counts of small and large Atlantic salmon at the Torrent River fishway, 1966-96.



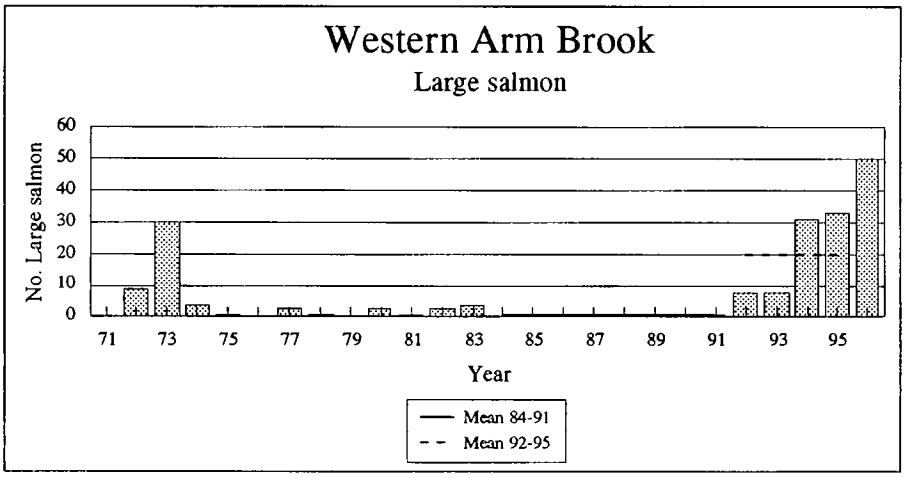


Figure 4. Counts of small and large Atlantic salmon at the Western Arm Brook counting fence, 1971-96.

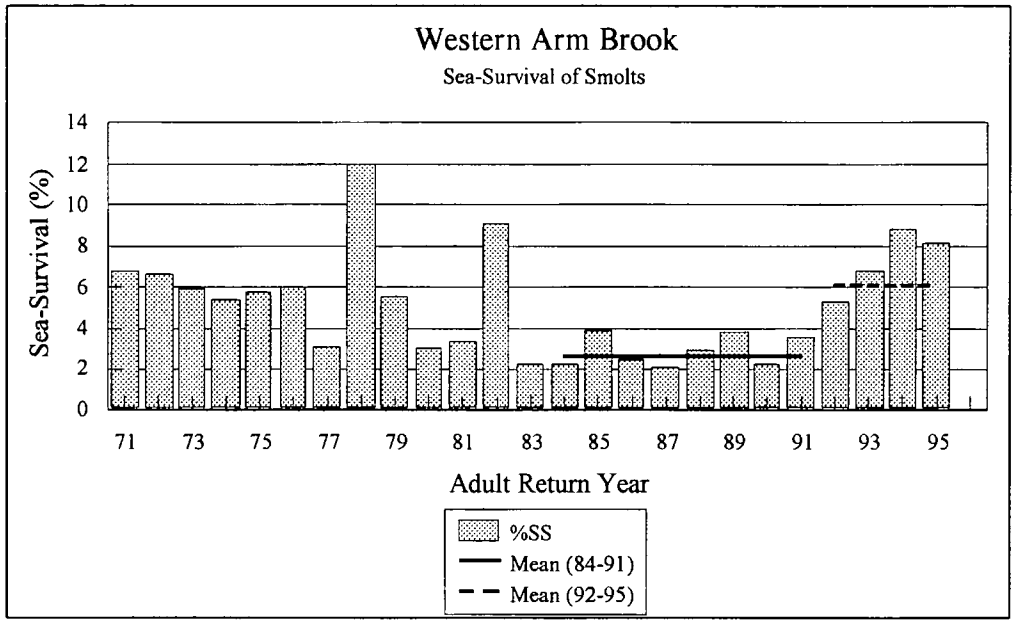
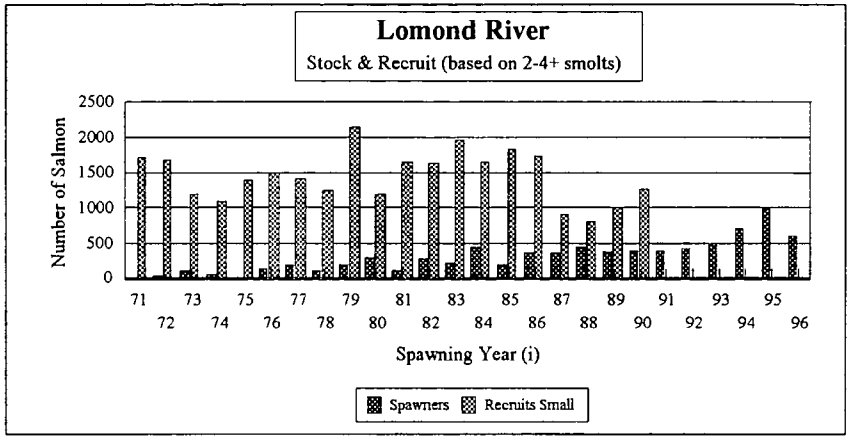
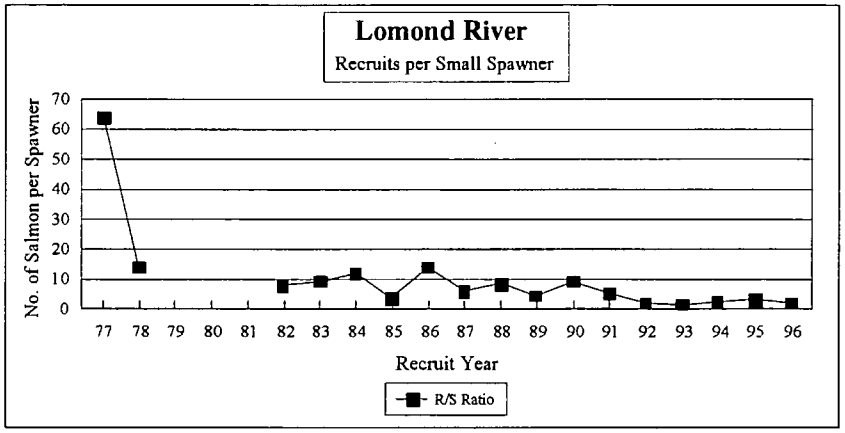
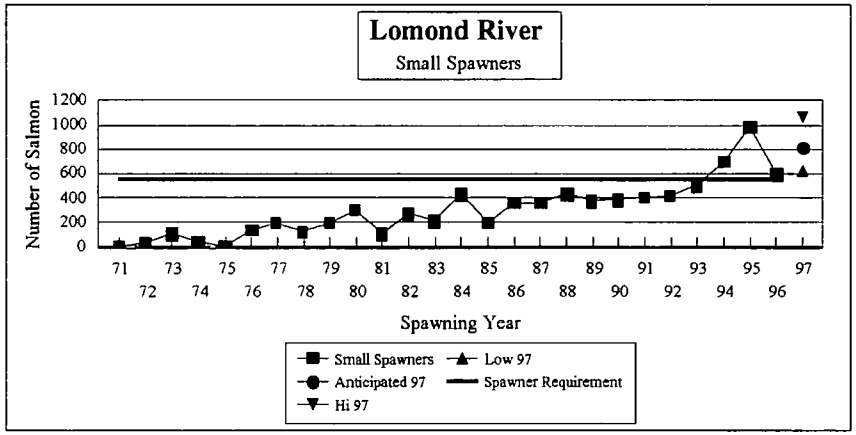


Figure 5. Percentage sea-survival of Atlantic salmon smolts from Western Arm Brook, 1971-95.







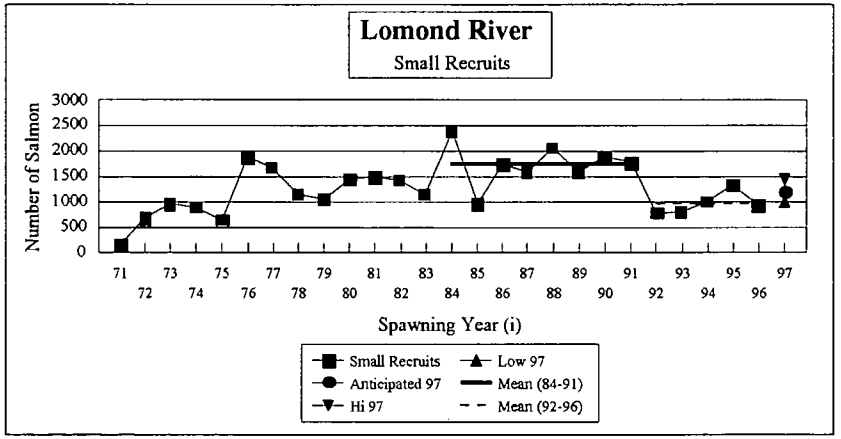
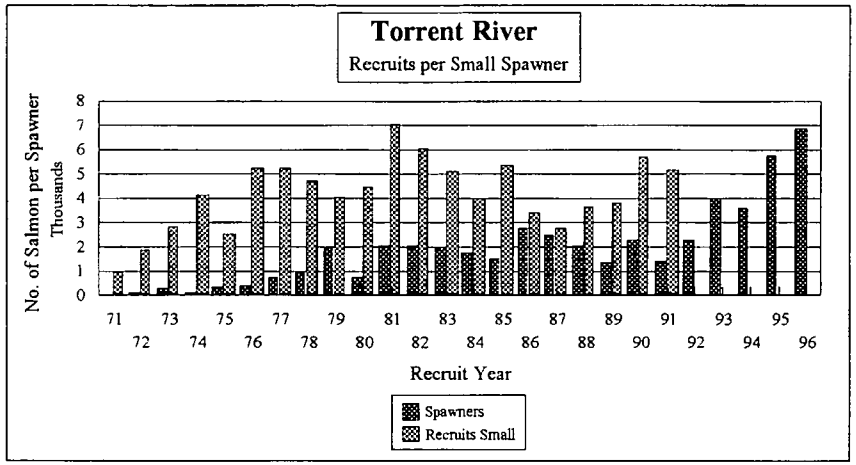
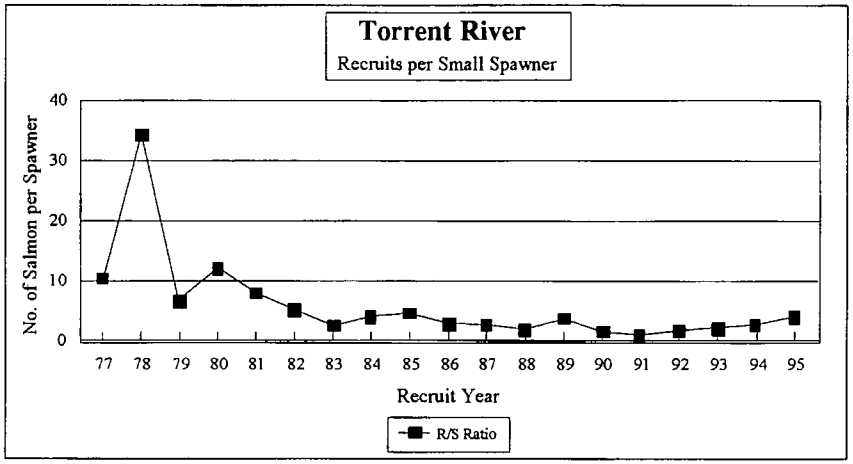
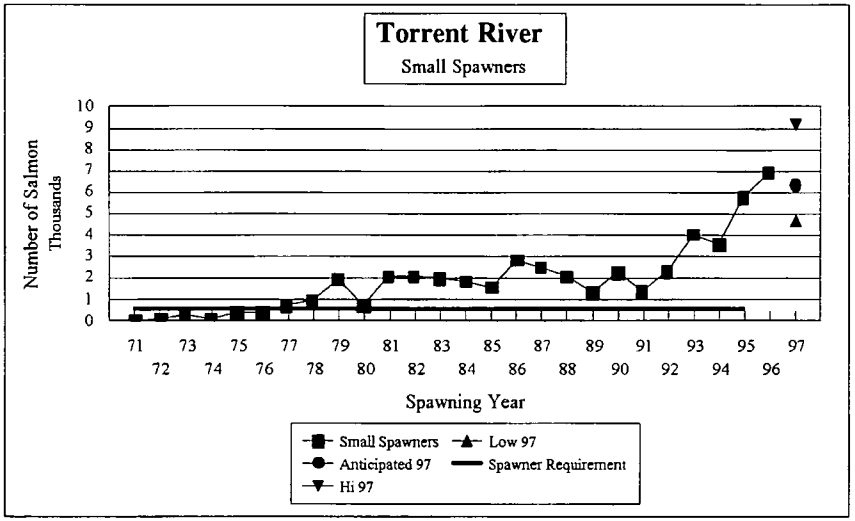


Figure 6. Relationship between spawners and recruits on the Lomond River and anticipated spawners and recruits in 1997. Horizontal line represents the conservation spawner requirement for small salmon.







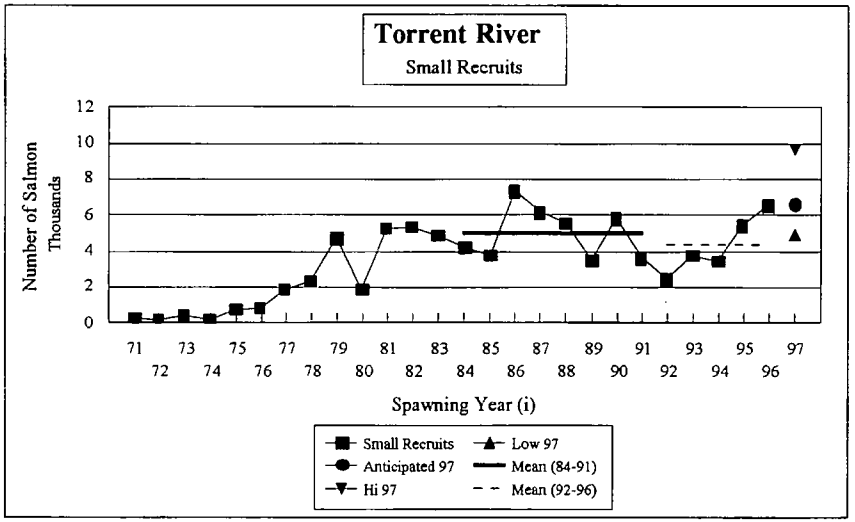
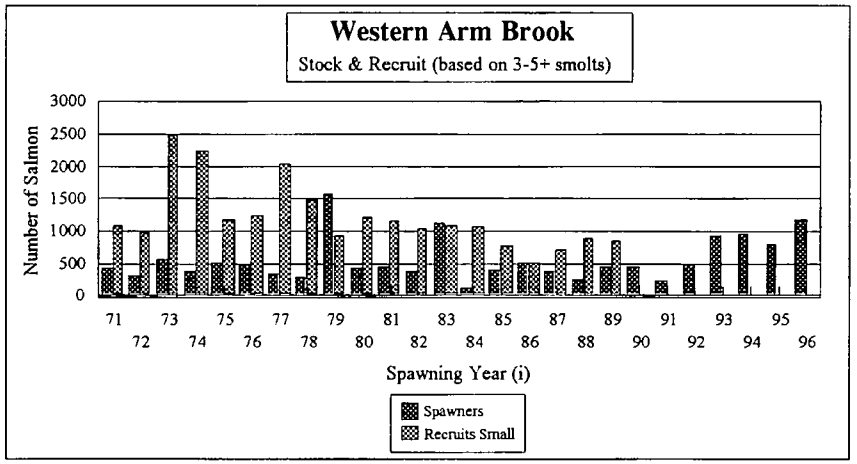
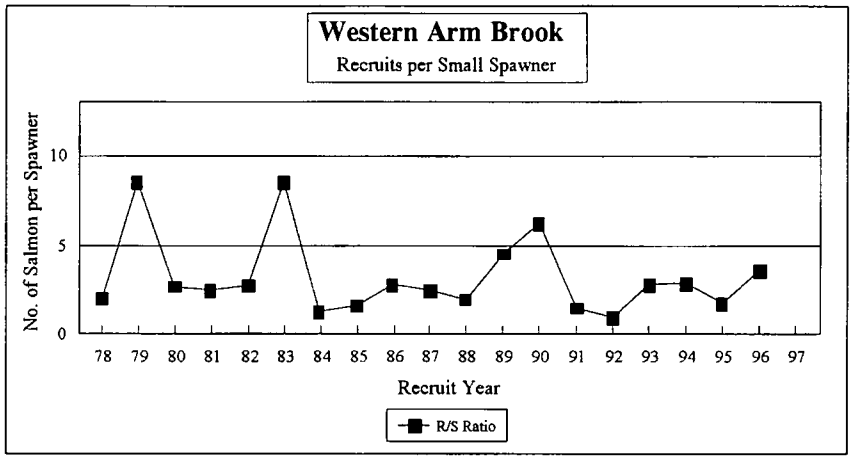
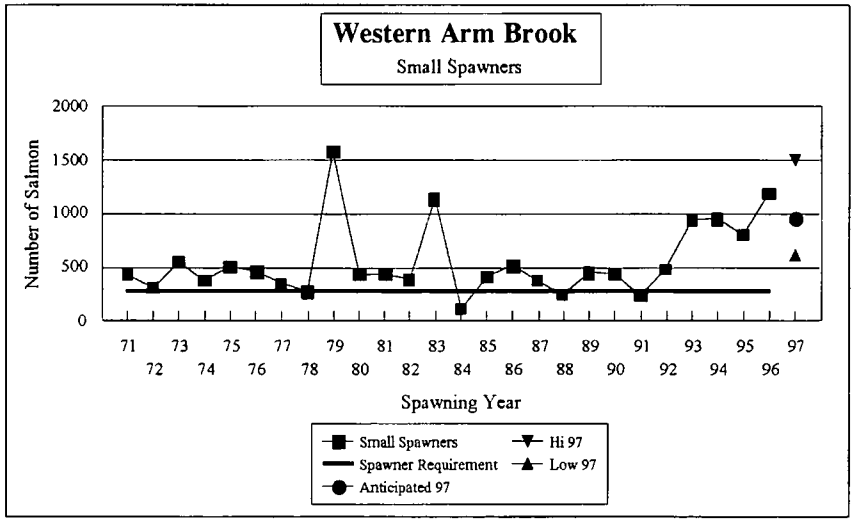


Figure 7. Relationship between spawners and recruits on Torrent River and anticipated spawners and recruits in 1997. Horizontal line represents the conservation spawner requirement of small salmon.







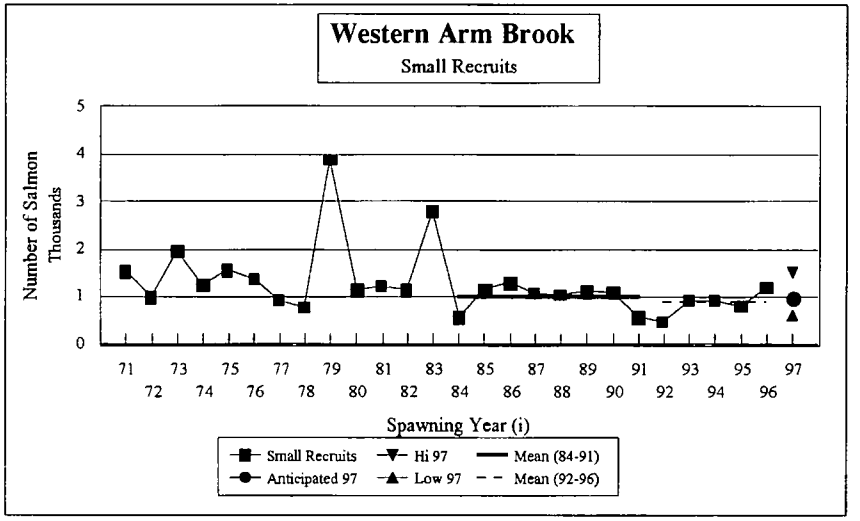


Figure 8. Relationship between spawners and recruits on Western Arm Brook and anticipated spawners and recruits in 1997. Horizontal line represents the conservation spawner requirement for small salmon.

Appendix 1. Sea-age distribution of small and large Atlantic salmon.

LOMOND RIVER

		SEA-AGE									
		1SW		CS 1SW		AS 1SW		2SW		Total	
		N	%	N	%	N	%	N	%	N	%
LARGE	YY										
	78	.	.	1	33.3	.	.	2	66.7	3	100.0
	79	1	100.0	.	.	.	.	.	.	1	100.0
	80	.	.	1	33.3	.	.	2	66.7	3	100.0
	81	.	.	.	.	.	.	1	100.0	1	100.0
	82	.	.	.	.	.	.	3	100.0	3	100.0
	84	.	.	.	.	.	.	4	100.0	4	100.0
	86	.	.	.	.	.	.	5	100.0	5	100.0
	92	1	4.0	2	8.0	7	28.0	15	60.0	25	100.0
	93	.	.	.	.	1	14.3	6	85.7	7	100.0
	94	.	.	.	.	.	.	1	100.0	1	100.0
	PRE-M	.	.	.	.	.	.	9	100.0	9	100.0
	MORAT.	1	3.0	2	6.1	8	24.2	22	66.7	33	100.0
	Total	2	3.8	4	7.5	8	15.1	39	73.6	53	100.0
SMALL	YY										
	75	1	100.0	.	.	.	.	.	.	1	100.0
	78	20	90.9	2	9.1	.	.	.	.	22	100.0
	79	39	100.0	.	.	.	.	.	.	39	100.0
	80	15	100.0	.	.	.	.	.	.	15	100.0
	81	37	94.9	2	5.1	.	.	.	.	39	100.0
	82	36	100.0	.	.	.	.	.	.	36	100.0
	83	15	100.0	.	.	.	.	.	.	15	100.0
	84	55	100.0	.	.	.	.	.	.	55	100.0
	85	32	97.0	1	3.0	.	.	.	.	33	100.0
	86	57	95.0	1	1.7	2	3.3	.	.	60	100.0
	88	6	100.0	.	.	.	.	.	.	6	100.0
	90	1	100.0	.	.	.	.	.	.	1	100.0
	91	1	100.0	.	.	.	.	.	.	1	100.0
	92	50	96.2	1	1.9	1	1.9	.	.	52	100.0
	93	75	93.8	5	6.3	.	.	.	.	80	100.0
	94	24	100.0	.	.	.	.	.	.	24	100.0
	95	43	100.0	.	.	.	.	.	.	43	100.0
	96	65	98.5	1	1.5	.	.	.	.	66	100.0
	PRE-M	152	97.4	2	1.3	2	1.3	.	.	156	100.0
	MORAT.	257	97.0	7	2.6	1	0.4	.	.	265	100.0
	Total	572	97.3	13	2.2	3	0.5	.	.	588	100.0

Appendix 2. Sea-age distribution of small and large Atlantic salmon.

TORRENT RIVER

		SEA-AGE													
		1SW		CS 1SW		AS 1SW		CS 2SW		2SW		3SW		Total	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
LARGE	YY														
	75	.	.	.	.	.	.	.	.	1	100.0	.	.	1	100.0
	80	.	.	1	100.0	.	.	.	.	.	.	.	.	1	100.0
	85	.	.	.	.	3	60.0	.	.	2	40.0	.	.	5	100.0
	86	.	.	1	11.1	4	44.4	.	.	4	44.4	.	.	9	100.0
	87	.	.	1	12.5	6	75.0	.	.	1	12.5	.	.	8	100.0
	88	.	.	5	50.0	4	40.0	.	.	1	10.0	.	.	10	100.0
	89	.	.	5	33.3	9	60.0	.	.	1	6.7	.	.	15	100.0
	90	1	100.0	.	.	.	.	.	.	.	.	.	.	1	100.0
	92	.	.	.	.	1	100.0	.	.	.	.	.	.	1	100.0
	93	2	1.4	41	28.7	1	0.7	44	30.8	54	37.8	1	0.7	143	100.0
	94	.	.	1	33.3	.	.	.	.	2	66.7	.	.	3	100.0
	96	.	.	.	.	.	.	1	50.0	1	50.0	.	.	2	100.0
	PRE-M	1	2.1	12	25.0	26	54.2	.	.	9	18.8	.	.	48	100.0
	MORAT.	2	1.3	42	28.2	2	1.3	45	30.2	57	38.3	1	0.7	149	100.0
	Total	3	1.5	55	27.6	28	14.1	45	22.6	67	33.7	1	0.5	199	100.0
SMALL	YY														
	75	15	100.0	.	.	.	.	.	.	.	.	.	.	15	100.0
	79	4	100.0	.	.	.	.	.	.	.	.	.	.	4	100.0
	80	55	94.8	3	5.2	.	.	.	.	.	.	.	.	58	100.0
	81	9	90.0	1	10.0	.	.	.	.	.	.	.	.	10	100.0
	83	16	100.0	.	.	.	.	.	.	.	.	.	.	16	100.0
	85	147	95.5	7	4.5	.	.	.	.	.	.	.	.	154	100.0
	86	290	95.1	15	4.9	.	.	.	.	.	.	.	.	305	100.0
	87	288	95.7	11	3.7	1	0.3	.	.	1	0.3	.	.	301	100.0
	88	196	89.1	24	10.9	.	.	.	.	.	.	.	.	220	100.0
	89	92	85.2	15	13.9	.	.	.	.	1	0.9	.	.	108	100.0
	90	36	92.3	3	7.7	.	.	.	.	.	.	.	.	39	100.0
	91	38	92.7	3	7.3	.	.	.	.	.	.	.	.	41	100.0
	92	17	100.0	.	.	.	.	.	.	.	.	.	.	17	100.0
	93	223	87.5	29	11.4	.	.	1	0.4	2	0.8	.	.	255	100.0
	94	20	90.9	2	9.1	.	.	.	.	.	.	.	.	22	100.0
	95	20	90.9	2	9.1	.	.	.	.	.	.	.	.	22	100.0
	96	34	94.4	2	5.6	.	.	.	.	.	.	.	.	36	100.0
	PRE-M	1087	93.1	78	6.7	1	0.1	.	.	2	0.2	.	.	1168	100.0
	MORAT.	314	89.2	35	9.9	.	.	1	0.3	2	0.6	.	.	352	100.0
	Total	1500	92.4	117	7.2	1	0.1	1	0.1	4	0.2	.	.	1623	100.0

Appendix 3. Sea-age distribution of small and large Atlantic salmon.

WESTERN ARM BROOK

		SEA-AGE																	
		1SW		CS 1SW		AS 1SW		MSW		CS 2SW		AS 2SW		2SW		Total	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
LARGE	YY																
	73	.	.	.	.	.	.	.	.	2	100.0	.	.	.	.	2	100.0
	77	.	.	.	.	2	100.0	.	.	.	.	.	.	.	.	2	100.0
	80	.	.	2	100.0	.	.	.	.	.	.	.	.	.	.	2	100.0
	81	.	.	1	50.0	.	.	.	.	1	50.0	.	.	.	.	2	100.0
	85	.	.	.	.	.	.	.	.	.	.	.	.	1	100.0	1	100.0
	87	1	100.0	.	.	.	.	.	.	.	.	.	.	.	.	1	100.0
	88	.	.	.	.	1	50.0	.	.	1	50.0	.	.	.	.	2	100.0
	89	.	.	1	100.0	.	.	.	.	.	.	.	.	.	.	1	100.0
	90	1	100.0	.	.	.	.	.	.	.	.	.	.	.	.	1	100.0
	91	1	100.0	.	.	.	.	.	.	.	.	.	.	.	.	1	100.0
	92	2	25.0	.	.	5	62.5	.	.	.	.	.	.	1	12.5	8	100.0
	93	1	25.0	.	.	.	.	.	.	1	25.0	.	.	2	50.0	4	100.0
	94	2	33.3	1	16.7	.	.	.	.	1	16.7	.	.	2	33.3	6	100.0
	95	.	.	.	.	31	91.2	.	.	.	.	.	.	3	8.8	34	100.0
	96	2	8.7	1	4.3	13	56.5	.	.	6	26.1	1	4.3	.	.	23	100.0
	PRE-M	3	42.9	1	14.3	1	14.3	.	.	1	14.3	.	.	1	14.3	7	100.0
	MORAT.	7	9.3	2	2.7	49	65.3	.	.	8	10.7	1	1.3	8	10.7	75	100.0
	Total	10	11.1	6	6.7	52	57.8	.	.	12	13.3	1	1.1	9	10.0	90	100.0
SMALL	YY																
	.	1	100.0	.	.	.	.	.	.	.	.	.	.	.	.	1	100.0
	71	154	99.4	.	.	.	.	.	.	.	.	.	.	1	0.6	155	100.0
	72	141	95.9	.	.	.	.	.	.	5	3.4	.	.	1	0.7	147	100.0
	73	267	99.6	.	.	.	.	.	.	.	.	.	.	1	0.4	268	100.0
	74	162	100.0	.	.	.	.	.	.	.	.	.	.	.	.	162	100.0
	75	36	100.0	.	.	.	.	.	.	.	.	.	.	.	.	36	100.0
	76	17	100.0	.	.	.	.	.	.	.	.	.	.	.	.	17	100.0
	77	113	100.0	.	.	.	.	.	.	.	.	.	.	.	.	113	100.0
	78	127	97.7	.	.	.	.	.	.	.	.	.	.	3	2.3	130	100.0
	79	449	99.6	.	.	.	.	.	.	.	.	.	.	2	0.4	451	100.0
	80	117	100.0	.	.	.	.	.	.	.	.	.	.	.	.	117	100.0
	81	130	97.0	4	3.0	.	.	.	.	.	.	.	.	.	.	134	100.0
	82	132	100.0	.	.	.	.	.	.	.	.	.	.	.	.	132	100.0
	83	189	99.5	1	0.5	.	.	.	.	.	.	.	.	.	.	190	100.0
	84	24	100.0	.	.	.	.	.	.	.	.	.	.	.	.	24	100.0
	85	79	98.8	.	.	.	.	.	.	.	.	.	.	1	1.3	80	100.0
	86	38	100.0	.	.	.	.	.	.	.	.	.	.	.	.	38	100.0
	87	81	100.0	.	.	.	.	.	.	.	.	.	.	.	.	81	100.0
	88	53	84.1	5	7.9	1	1.6	4	6.3	.	.	.	.	.	.	63	100.0
	89	140	100.0	.	.	.	.	.	.	.	.	.	.	.	.	140	100.0
	90	46	97.9	1	2.1	.	.	.	.	.	.	.	.	.	.	47	100.0
	91	224	100.0	.	.	.	.	.	.	.	.	.	.	.	.	224	100.0
	92	407	99.8	.	.	.	.	.	.	.	.	.	.	1	0.2	408	100.0
	93	251	86.3	38	13.1	.	.	.	.	1	0.3	.	.	1	0.3	291	100.0
	94	103	96.3	4	3.7	.	.	.	.	.	.	.	.	.	.	107	100.0
	95	97	100.0	.	.	.	.	.	.	.	.	.	.	.	.	97	100.0
	96	76	100.0	.	.	.	.	.	.	.	.	.	.	.	.	76	100.0
	PRE-M	685	98.3	6	0.9	1	0.1	4	0.6	.	.	.	.	1	0.1	697	100.0
	MORAT.	934	95.4	42	4.3	.	.	.	.	1	0.1	.	.	2	0.2	979	100.0
	Total	3654	98.0	53	1.4	1	0.0	4	0.1	6	0.2	.	.	11	0.3	3729	100.0

Appendix 4 . Atlantic salmon recreational fishery catches and effort for Lomond River, 1953-96.
Note: Ret. = 'Retained' and Rel. = 'Released'.

Year	Effort (Rod Days)	Small			Large			Total Catch			CPUE
		Ret.	Rel.	Total	Ret.	Rel.	Total	Ret.	Rel.	Total	
1953	359	93	.	93	22	.	22	115	.	115	0.32
1954	423	81	.	81	27	.	27	108	.	108	0.26
1955	448	113	.	113	12	.	12	125	.	125	0.28
1956	306	130	.	130	28	.	28	158	.	158	0.52
1957	254	116	.	116	14	.	14	130	.	130	0.51
1958	359	144	.	144	32	.	32	176	.	176	0.49
1959	419	196	.	196	65	.	65	261	.	261	0.62
1960	503	124	.	124	28	.	28	152	.	152	0.30
1961	403	160	.	160	33	.	33	193	.	193	0.48
1962	778	201	.	201	32	.	32	233	.	233	0.30
1963	811	320	.	320	32	.	32	352	.	352	0.43
1964	971	349	.	349	24	.	24	373	.	373	0.38
1965	170	292	.	292	50	.	50	342	.	342	2.01
1966	347	229	.	229	61	.	61	290	.	290	0.84
1967	568	217	.	217	21	.	21	238	.	238	0.42
1968	454	202	.	202	3	.	3	205	.	205	0.45
1969	391	147	.	147	5	.	5	152	.	152	0.39
1970	457	145	.	145	29	.	29	174	.	174	0.38
1971	217	54	.	54	1	.	1	55	.	55	0.25
1972	1648	253	.	253	35	.	35	288	.	288	0.17
1973	1232	286	.	286	55	.	55	341	.	341	0.28
1974	1331	324	.	324	19	.	19	343	.	343	0.26
1975	773	258	.	258	20	.	20	278	.	278	0.36
1976	2045	650	.	650	25	.	25	675	.	675	0.33
1977	1461	495	.	495	34	.	34	529	.	529	0.36
1978	1267	345	.	345	29	.	29	374	.	374	0.30
1979	900	235	.	235	2	.	2	237	.	237	0.26
1980	1218	293	.	293	13	.	13	306	.	306	0.25
1981	1446	507	.	507	3	.	3	510	.	510	0.35
1982	1435	308	.	308	7	.	7	315	.	315	0.22
1983	1112	251	.	251	3	.	3	254	.	254	0.23
1984	1505	546	.	546	28	.	28	574	.	574	0.38
1985	1075	203	.	203	.	2	2	203	2	205	0.19
1986	1164	371	.	371	.	46	46	371	46	417	0.36
1987	1186	297	.	297	.	13	13	297	13	310	0.26
1988	1545	404	.	404	.	25	25	404	25	429	0.28
1989	1714	270	.	270	.	5	5	270	5	275	0.16
1990	1938	386	.	386	.	17	17	386	17	403	0.21
1991	1519	328	.	328	.	10	10	328	10	338	0.22
1992	1612	357	24	381	.	56	56	357	80	437	0.27
1993	2190	281	85	366	.	40	40	281	125	406	0.19
1994	2017	325	116	441	.	58	58	325	174	406	0.20
1995	2043	343	190	533	.	62	62	343	252	595	0.29
1996	2700	371	99	470	.	49	49	371	148	519	0.19
Mean (92-95)	1966	327	104	430	.	54	54	327	158	461	0.24
95% CL=+/-	394	53	110	121	.	15	15	53	117	144	0.08
N	4	4	4	4	.	4	4	4	4	4	4
Mean(84-91)	1456	351	.	351	.	17	18	354	17	369	0.26
95% CL=+-	248	86	.	86	.	14	12	93	14	94	0.07
N	8	8	.	8	.	7	8	8	7	8	8
Mean(78-83)	1230	323	.	323	10	.	10	333	.	333	0.27
95% CL=+-	217	103	.	103	11	.	11	104	.	104	0.05
N	6	6	.	6	6	.	6	6	.	6	6

Appendix 5 . Recreational catch and effort of Atlantic salmon on Torrent River, 1953-96.
Note: Ret. = 'Retained' and Rel. = 'Released'.

Year	Effort (Rod-days)	Small			Large			Total Catch			CPUE
		Ret.	Rel.	Total	Ret.	Rel.	Total	Ret.	Rel.	Total	
1953	169	4	.	4	9	.	9	13	.	13	0.08
1954	187	15	.	15	3	.	3	18	.	18	0.10
1955	184	22	.	22	15	.	15	37	.	37	0.20
1956	464	51	.	51	29	.	29	80	.	80	0.17
1957	377	73	.	73	21	.	21	94	.	94	0.25
1958	594	24	.	24	34	.	34	58	.	58	0.10
1959	585	31	.	31	54	.	54	85	.	85	0.15
1960	401	54	.	54	32	.	32	86	.	86	0.21
1961	569	37	.	37	43	.	43	80	.	80	0.14
1962	893	107	.	107	37	.	37	144	.	144	0.16
1963	1286	107	.	107	64	.	64	171	.	171	0.13
1964	593	66	.	66	40	.	40	106	.	106	0.18
1965	455	62	.	62	36	.	36	98	.	98	0.22
1966	794	43	.	43	13	.	13	56	.	56	0.07
1967	598	36	.	36	11	.	11	47	.	47	0.08
1968	998	70	.	70	7	.	7	77	.	77	0.08
1969	315	41	.	41	4	.	4	45	.	45	0.14
1970	277	52	.	52	9	.	9	61	.	61	0.22
1971	333	53	.	53	5	.	5	58	.	58	0.17
1972	306	22	.	22	3	.	3	25	.	25	0.08
1973	413	88	.	88	3	.	3	91	.	91	0.22
1974	400	58	.	58	4	.	4	62	.	62	0.16
1975	364	123	.	123	6	.	6	129	.	129	0.35
1976		.	.	0	.	.	0	0	.	0	.
1977		.	.	0	.	.	0	0	.	0	.
1978	183	31	.	31	4	.	4	35	.	35	0.19
1979	238	65	.	65	3	.	3	68	.	68	0.29
1980		.	.	0	.	.	0	0	.	0	.
1981	656	167	.	167	18	.	18	185	.	185	0.28
1982	535	187	.	187	2	.	2	189	.	189	0.35
1983	354	82	.	82	1	.	1	83	.	83	0.23
1984	.	.	.	.	.	.		.	.	.	.
1985	251	70	.	70	.	0	0	70	0	70	0.28
1986	767	340	.	340	.	5	5	340	5	345	0.45
1987	576	165	.	165	.	0	0	165	0	165	0.29
1988	803	313	.	313	.	0	0	313	0	313	0.39
1989	559	143	.	143	.	0	0	143	0	143	0.26
1990	629	222	.	222	.	4	4	222	4	226	0.36
1991	438	150	.	150	.	1	1	150	1	151	0.34
1992	727	477	75	552	.	6	6	477	81	558	0.77
1993	619	179	266	445	.	15	15	179	281	460	0.74
1994	992	227	82	309	.	9	9	227	91	318	0.32
1995	1816	331	369	700	.	36	36	331	405	736	0.41
1996	2027	421	270	691	.	20	20	421	290	711	0.35
Mean (92-95)	1039	304	198	502	.	17	17	304	215	518	0.56
95% CL=+/-	862	210	230	263	.	22	22	210	250	279	0.36
N	4	4	4	4	.	4	4	4	4	4	4
Mean(84-91)	503	175	.	175	.	1	1	175	1	177	0.30
95% CL=+-	225	96	.	96	.	2	2	96	2	97	0.11
N	8	8	.	8	.	7	8	8	7	8	8
Mean(78-83)	393	89	.	89	5	.	5	93	.	93	0.22
95% CL=+-	209	78	.	78	7	.	7	82	.	82	0.13
N	6	6	.	6	6	.	6	6	.	6	6

Appendix 6 . Recreational catch and effort of Atlantic salmon on Western Arm Brook, 1960-96.
Note: Ret. = 'Retained' and Rel. = 'Released'.

Year	Effort (Rod-days)	Small			Large			Total Catch			CPUE
		Ret.	Rel.	Total	Ret.	Rel.	Total	Ret.	Rel.	Total	
1960											
1961	3	1	.	1	0	.	0	1	.	1	0.33
1962	44	38	.	38	0	.	0	38	.	38	0.86
1963	97	86	.	86	0	.	0	86	.	86	0.89
1964	171	130	.	130	0	.	0	130	.	130	0.76
1965	214	123	.	123	0	.	0	123	.	123	0.57
1966	273	219	.	219	0	.	0	219	.	219	0.80
1967	261	192	.	192	0	.	0	192	.	192	0.74
1968	298	176	.	176	0	.	0	176	.	176	0.59
1969	296	323	.	323	13	.	13	336	.	336	1.14
1970	420	294	.	294	42	.	42	336	.	336	0.80
1971	128	205	.	205	0	.	0	205	.	205	1.60
1972	100	97	.	97	0	.	0	97	.	97	0.97
1973	409	243	.	243	0	.	0	243	.	243	0.59
1974	361	124	.	124	0	.	0	124	.	124	0.34
1975	155	8	.	8	0	.	0	8	.	8	0.05
1976	115	32	.	32	0	.	0	32	.	32	0.28
1977	107	11	.	11	0	.	0	11	.	11	0.10
1978	168	22	.	22	1	.	1	23	.	23	0.14
1979	5	0	.	0	0	.	0	0	.	0	0.00
1980	175	30	.	30	2	.	2	32	.	32	0.18
1981	209	41	.	41	0	.	0	41	.	41	0.20
1982	379	73	.	73	0	.	0	73	.	73	0.19
1983	15	0	.	0	0	.	0	0	.	0	0.00
1984	432	115	.	115	0	.	0	115	.	115	0.27
1985	204	46	52	98	.	1	1	46	53	99	0.49
1986	83	.	17	17	.	0	0	0	17	17	0.20
1987	269	59	.	59	.	2	2	59	2	61	0.23
1988	701	171	.	171	.	0	0	171	0	171	0.24
1989	.	.	.	.	.	.	.	.	.	.	.
1990	.	.	.	.	.	.	.	.	.	.	.
1991	.	.	.	.	.	.	.	.	.	.	.
1992	.	.	.	.	.	.	.	.	.	.	.
1993	.	.	.	.	.	.	.	.	.	.	.
1994	.	.	.	.	.	.	.	.	.	.	.
1995	.	.	.	.	.	.	.	.	.	.	.
1996	.	.	.	.	.	.	.	.	.	.	.
Mean (92-95)	.	.	.	.	.	.	.	.	.	.	.
95% CL=+/-	.	.	.	.	.	.	.	.	.	.	.
N	.	.	.	.	.	.	.	.	.	.	.
Mean(84-91)	338	78	.	92	.	1	1	78	18	93	0.29
95% CL=+-	297	82	.	72	.	1	1	82	25	72	0.14
N	5	5	.	5	.	4	5	5	4	5	5
Mean(78-83)	159	28	.	28	1	.	1	28	.	28	0.12
95% CL=+-	145	29	.	29	1	.	1	29	.	29	0.10
N	6	6	.	6	6	.	6	6	.	6	6